

# Assessment of Deer Hunting in NJ

## Chapter 1.

### DESCRIPTION OF THE PROPOSAL

#### The Proposal

The Division of Fish, Game and Wildlife proposes to continue issuing annual regulations which establish open seasons, season lengths, daily bag and possession limits, shooting hours, methods of take and other special management provisions, thus permitting the sport hunting of white-tailed deer (*Odocoileus virginianus*), which will help maintain a healthy deer population at a level that is compatible with other land uses while maximizing the recreational use of the resource by the citizens of the State of New Jersey.

Annual regulations may vary as the harvest of a particular species is regulated to achieve a desired population level or goal. In those species in which sport hunting can significantly affect population levels, regulations generally become restrictive as population levels decrease and more liberal as populations increase. In species where sport hunting has no significant effect on population levels, regulations remain relatively unchanged on an annual basis.

### OBJECTIVES

#### Recreational

The maximum number of recreation days should be provided to the largest number of resource users, while keeping the other objectives in perspective. In 1997, 1,600,000 man-days of recreation were provided to 100,000 deer hunters in this state. Recreation was also provided to nonconsumptive

resource users such as photographers, students and people interested in watching deer.

#### Population Control

The deer population should be kept at or below the carrying capacity of the land, and at a level that is compatible with other legitimate land uses.

#### Damage Control

Land uses such as farming, commercial nursery operations, gardening and landscaping are often adversely affected by deer. In calendar year 1997, 150 homeowners and 436 farmers reported damage to the Wildlife Control Section of the Division of Fish, Game & Wildlife. Population control reduces deer damage to vegetation and the number of deer-auto collisions. In the absence of population control, man-deer conflicts would increase as the deer population increased.

#### Economic

The economic objective of the proposed action is to reduce the negative impact of deer damage and auto-deer collisions, and to maintain the positive impact.

The positive economic impact of sport hunting on the recreation industry and government is significant. According to the *1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation*, hunters expended \$117.3 million in pursuit of their sport in New Jersey. Expenditures for nonconsumptive activities relating to deer such as photography or observation were also significant.

If an average deer in New Jersey weighs 90 pounds, then approximately 45 pounds of

meat can be taken from it. At the average price of \$2.39 per pound of ground beef, the value of venison from the 1997 harvest was \$6.40 million. At \$9.95 per pound, the price of imported white-tailed deer venison sold commercially, the value of venison from the 1997 harvest was \$26.7 million (personal communication, Robert Blazer).

Reduction of the negative economic impact of deer damage to commercial farms and private gardens, and auto-vehicle collisions are other important economic considerations.

## **Research**

The harvest of white-tailed deer on an annual basis provides an opportunity for wildlife biologists to collect large quantities of valuable information on the condition and productivity of the deer herd, statewide. Without the annual harvest, the Deer Research Project would be limited to collecting information from road kills, illegal kills, damage control killed deer, dead deer searches and other sources which are also currently utilized. The loss of information from hunter harvests would impair research and subsequently the management of the resource.

## **AUTHORITY FOR REGULATORY ACTION**

The Fish and Game Council within the Division of Fish, Game and Wildlife (part of the Department of Environmental Protection), adopts the **GAME CODE** under authority of the N.J.S.A. set forth in Title 23, Chapter 2, Article V, Paragraph 13:1B-29 *et seq.* "The Council (Fish and Game Council) is hereby authorized and empowered to determine under what circumstances, when and in what localities, by what means and in what amounts and numbers such fresh water fish, game birds, game animals and furbearing animals, or any of them, may be pursued, taken, killed or had in possession so

as to maintain an adequate and proper supply thereof and may . . . . . adopt from time to time amend and repeal such appropriate and reasonable regulations concerning the same . . ."

The procedure for establishing regulations is set forth in Paragraphs 13:1B-31 through 13:1B-34. The procedure is as follows: Recommendations for regulations are made by Division personnel "on the basis of scientific investigation and research" to the Fish and Game Council for consideration. Prior to adoption of a regulation by the Council interested persons are given the opportunity to submit written comments, and a public hearing is held. After the public comment period, the Council will vote to refuse, accept or amend each regulation.

Note: A question was raised in 1974 by several special interest groups which oppose sport hunting, regarding the constitutionality of the makeup of the Fish and Game Council. The Council (in accordance with Paragraph 13:1B-24) is made up of eleven members. The Governor, with the advice and consent of the Senate, appoints the members. Membership of the council consists of three farmer representatives, six sportsmen representatives, the chairman of the Endangered & Nongame Species Advisory Committee, and a person knowledgeable in land management and soil conservation practices. (The Supreme Court of the State of New Jersey ruled that the make-up of the Council was legal and within the limits of the Constitution of the State of New Jersey. *Humane Society of the U.S. v. NJ State Fish and Game Coun.*, 70 NJ 565 (1976) appeal dismissed 429 U.S. 1032, 50 L.Ed.2d 744).

## **HISTORY AND FORMULATION OF REGULATORY ACTION**

The right to hunt was first established by the Concessions and Agreements of 1678. This Act extended hunting rights on "All the lands

of the Province, not surveyed or planted" (Brewster 1911). In 1679, the General Assembly of the Province of New Jersey enacted a law prohibiting the export of Indian dressed hides (Brewster 1911). This was the first statute relating to game in New Jersey and the first law prohibiting the export of skins in the colonies. The first seasonal restriction on killing deer was established in 1722 (Brewster 1911). In 1771, a deer season was established, September 1st through December 31st, by action of the General Assembly (Brewster 1911). Regulations prohibiting the trapping of deer, the use of set guns and trespassing on private land for the purpose of hunting were enacted the same year (Brewster 1911). The first prohibition of deer hunting on a local basis was made by the General Assembly in 1772; the Act forbade hunting in the Township of Morris and in the "Great Swamp" for five years (Brewster 1911).

In 1776, deer hunting was restricted to "one's own land," and the season was set for September 1st through December 31st (Brewster 1911). "An Act for suppressing immorality" was passed in 1798 that prohibited hunting and fishing on Sunday (Brewster 1911). Deer hunting was closed in Bergen, Atlantic and Ocean Counties for five years beginning in 1853 (Brewster 1911).

In 1870, the Board of Fish and Game Commissioners was created, having two members (Musick 1974). The deer season was reduced to 2 1/2 months in 1874, running from October 15th through January 1st. Burlington and Ocean Counties were closed for five years (Brewster 1911). In 1881, the entire State was closed to deer hunting for three years (Brewster 1911). Similar closings took place in 1889 and 1899 (Brewster 1911).

In 1894, the New Jersey State Board of Fish and Game Commissioners was increased to four members (Brewster 1911). The Commission maintained this status for 23 years. Deer hunting in the entire State was

closed again in 1902 and remained closed through 1908 (Brewster 1911). The next year, legislation was passed requiring residents to purchase hunting licenses and establishing an annual deer season which has been held every year to date. Also, laws prohibiting the use of dogs and night hunting, and permitting the harvest of only bucks with visible antlers were passed at the same session. A \$100 fine was established for a violation of any of these restrictions (Brewster 1911). At the time, this fine represented a man's salary for three or four months.

A law passed in 1913 made the export of deer hides illegal (Board of Fish & Game Committee 1914). In 1928 the number of Board of Fish & Game Commissioners was increased to nine (Board of Fish & Game Comm. 1929).

In 1945, many governmental changes occurred in New Jersey. The Division of Fish, Game and Shellfisheries was created with an advisory Fish and Game Council (Musick 1974). The then-existing nine member Board of Fish and Game Commissioners, who had all been appointed by the Governor, became the first Council members (Musick 1974). In 1948, the organization was changed to the Department of Conservation and Economic Development and provided for a Fish and Game Council with eleven members (Musick 1974). Three members were designated to be farmers, recommended to the Governor by the agricultural convention. Six members were sportsmen recommended by the New Jersey Federation of Sportsmen's Clubs, and two members were commercial fishermen to be selected by the Governor. In 1979, the Marine Fisheries and Management Act was signed into law, and the two commercial fishermen left the Fish and Game Council to join the newly formed Marine Fisheries Council. These two vacancies were filled by the chairman of the Endangered and Nongame Species Advisory Committee and a person knowledgeable in land management

and soil conservation practices. The members of the Council serve four-year terms. The law stipulated that a Director be appointed by the Council to supervise the Division, and administer the work under the direction and supervision of the Council (Musick 1974).

The Department of Environmental Protection replaced the Department of Conservation and Economic Development in April of 1970. The Units consolidated in this new agency included the present Division of Fish, Game & Wildlife (Musick 1974).

## **CURRENT REGULATION PROCEDURE**

The Deer Research Project of the Bureau of Wildlife Management is the principal unit charged with conducting field investigations and data analysis relating to white-tailed deer. After pertinent data is collected and analyzed by the Project biologists, specific recommendations are made and submitted by the Bureau of Wildlife Management to the Office of the Director. The Director may make further recommendations prior to submitting them to the Fish and Game Council. The Council considers these recommendations and the views and opinions of interested citizens in promulgation of the proposed regulations each fiscal year. Proposed amendments in the **GAME CODE** are published in the *New Jersey Register*. After considering written comments and comments received at a public hearing held in mid-June, the Fish and Game Council adopts the **GAME CODE** pursuant to the New Jersey Constitution Art. V, Sec. IV, Paragraph 6 and the Administrative Procedure Act, N.J.S.A. 52:14B-1 *et seq.* under authority of the N.J.S.A. 13:1B-29 *et seq.* and the provisions of the N.J.S.A. 23:1-1 *et seq.* Notice of adoption is published in the *New Jersey Register* in or about August, frequently with minor technical changes so that the value of the original notice remains

intact. Note: general regulations are published in the August issue of the *New Jersey Fish and Wildlife Digest*.

## **SCOPE OF THE REGULATIONS**

N.J.S.A. 13:1B-26 *et seq.* outlines the procedures to be followed in the development of the fish and game regulations. The Fish and Game Council of the Division of Fish, Game and Wildlife is authorized to establish, extend, shorten or abolish seasons; change bag limits; and, prescribe manner and means of pursuing, taking or killing any species of game or fish. The six deer seasons are established and regulated according to the requirements of New Jersey State law.

The white-tailed deer is New Jersey's only big game animal with a prescribed, open hunting season. There are no "natural" predators in within this State that would help maintain deer in balance with their habitat. Consequently, it is essential to have some of these animals removed by sport hunting, the most effective and economical population control method. Since white-tailed deer provide the only opportunity to hunt a big game species in New Jersey, the recreational and economic impact is significant.

The six 1997 deer seasons provided estimated 1.6 million recreation days afield for deer hunters in New Jersey. When pre-season preparation for deer hunting is considered, many more man-days were provided. The Fall Bow and Arrow season provided 24-42 days to hunt. The Permit Bow and Arrow season provided 25-51 days to bow permittees. There were six days of the Firearm Buck season, and 1-25 days to hunt during the Permit Shotgun season, depending on the zone. The Permit Muzzleloader season provided 9-16 days of recreation, including two days prior to the Six-day Firearm season, to holders of the muzzleloader permit and Winter Bow provided 28 days of hunting opportunity. A

total of 120 days were available during the 1997-98 deer seasons. Approximately 48,000 bow hunters, 86,000 shotgun hunters and 22,000 muzzleloader hunters participated in the 1997 deer seasons.

## **1997-98 REGULATIONS**

Regulations pertaining to deer in New Jersey are found in N.J.A.C. 7:25-5. These regulations implement the statutory requirements found in those portions of N.J.S.A. 23.

## **Chapter 2.**

### **DESCRIPTION OF THE ENVIRONMENT**

### **THE RESOURCE**

#### **Taxonomy**

The white-tailed deer is a member of the order Artiodactyla. The members of this order have an even number of well-developed digits (with the exception of the family *Tayassuidae*) with the main axis of the limb passing between the median digits. The weight of the body is supported by the median digits (Walker 1968).

The nine families and 82 genera of the order Artiodactyla are found throughout the world except Australia, Antarctica and some isolated islands. The nine families of this order are the *Suidae* (hogs), *Hippopotamidae* (hippopotamuses), *Camelidae* (camels, guanacos, llamas, alpacas and vicuñas), *Tayassuidae* (peccaries), *Tragulidae* (mouse deer), *Giraffidae* (giraffes and okapis), *Antilocapridae* (pronghorn antelopes), *Bovidae* (bushbucks, kudus, elands, buffaloes,

cattledrunkers, antelope, wildebeests, gazelles, goats, sheep, bosbaks, nilgais, waterbucks, cranes, bison, bongos), and *Cervidae* (deer) (Walker 1968).

The family Cervidae contains four subfamilies, 17 genera and approximately 37 species distributed throughout North America, South America (to 40 degree latitude), northwestern Africa, Eurasia, Japan, the Philippines and Indonesia. The extant genera of the family are: *Alces* (moose, European elk); *Axis* (chital - 2 species); *Blastocerus* (Pampas deer); *Capreolus* (roe deer); *Cervulus* (muntjac - 4 species); *Cervus* (red deer, wapiti - approximately 11 species); *Dama* (fallow deer); *Elaphodus* (tufted deer); *Elaphurus* (Pere David's deer); *Hippocamelus* (huemul - 2 species); *Hydropotes* (Chinese water deer); *Mazama* (brocket - 4 species); *Moschus* (musk deer); *Odocoileus* (mule deer, white-tailed deer); *Ozotoceros* (swamp deer); *Pudu* (pudu - 2 species); and, *Rangifer* (caribou, reindeer).

The Cervidae are best characterized by the presence of antlers. The white-tailed deer belongs to the genus *Odocoileus* that contains two species, *O. virginianus*, white-tailed deer and *O. hemionus*, mule deer (Walker 1968). The two species are distinguishable by the shape and configuration of the antlers, the length of the sub-basal snag on the antlers, the lengths of the ears and metatarsal glands, the color of the dorsal tail hairs, and the condition of the lacrimal fossa. Distinguishing between the two species is a problem only where their ranges overlap (Halls, 1984).

There are 30 recognized subspecies of white-tailed deer occupying almost all of Central and North America with the exception of the Arctic and sub-arctic, most of California and part of the Great Basin area (Halls 1984).

An integration of subspecies may exist in New Jersey due to early stocking programs, when deer were obtained from other states such as Michigan and Pennsylvania. Historically, *O. virginianus borealis*, the

northern woodland white-tailed deer, was the subspecies present in New Jersey. Its original range extended from western Ontario, south along the Mississippi River and eastward along the Ohio and Potomac Rivers (Hall 1984). *O. v. borealis* attains a large size, having a possible height at the shoulder of 104.1 cm and a length of 240 cm. The winter pelage is a grizzled pattern of Brussels Brown with a median longitudinal streak darker than the remainder of the coat following the spinal column. The color of the top of the tail is similar and is broadly fringed with white above and pure white to the tip below (Taylor 1956). The summer pelage is a clear tawny color, giving a reddish appearance (Barbour 1922).

## Life History

Unbroken forests are not optimum white-tailed deer habitat. White-tailed deer develop their largest populations in areas where "edges" are abundant and in areas of mixed vegetation types. Townsend and Smith (1933) stressed the importance of an open canopy, through which light can penetrate. Foote (1945) stated that deer were originally found in greater numbers in the southern portions of Vermont. Lightning fires in that area created openings that soon supported growth of preferred forage for white-tailed deer. The importance of burned areas in southern New Jersey was highlighted by Little et. al. (1958).

McCaffery and Creed (1969) found deer activity to be significantly higher in forest openings. It appeared that this difference was related to forage preferences. Leopold (1950) stated that the shrub and tree reproduction, which constitute staple items of a deer's diet, are characteristic of sub-climax ecological conditions. In other words, disturbed areas are the most productive for deer.

Much of New Jersey's potential deer habitat has been disturbed at one time or another. Many areas are in various stages of secondary succession, as abandoned farmland reverts to woodland. Fires, timber operations, and power line maintenance serve to provide vegetation communities in early successional stages.

Summer range, though threatened by human expansion and development, is not a serious limiting factor to white-tailed deer populations in New Jersey at this time. Even small woodlots produce enough growth to be of some value to deer. In general, during the summer months white-tails inhabit nearly all available range when an abundance of good forage exists. The growing season provides a more than adequate food supply and provides cover for adults and fawns alike.

Farming provides open fields in the northern zones that are used by does with newborn fawns. Disturbed areas such as burns and power line cuts provide fawning areas in southern New Jersey. Agricultural operations exert a substantial effect on white-tail populations, and New Jersey's heavily farmed Hunterdon, Sussex and Warren Counties consistently produce large numbers of deer. Agricultural activities in these prime counties provide deer with large quantities of quality foods, maintain open space and provide the preferred edge habitat.

Southern New Jersey summer range includes both upland and lowland area. Lowland areas are preferred because of the type of forage found there (Little, et. al. 1958). Disturbed upland sites also produce ample forage and cover for white-tails in summer.

The best range exists in zones where extensive agricultural operations persist. Interspersed woodlots, second growth, and cropland provide deer with the necessary combination of food and cover. Water is readily available on all deer range in New Jersey.

The outer coastal plain soils of the south, are highly leached, quite acidic, and less fertile than those in the northern and central regions. The high quality browse, Atlantic white-cedar (*Chamaecyparis thyoides*), is being depleted by the activities of both deer and man, and will undoubtedly become a limiting factor on outer coastal plain deer populations in future years.

In cold weather, white-tails concentrate in "wintering areas." These sites are characteristically sheltered coves and hollows, areas where the topography and patches of evergreens such as eastern hemlock (*Tsuga canadensis*), mountain laurel (*Kalmia latifolia*), and rhododendron (*Rhododendron maximum*) afford protection from the elements (Gerstell 1938, Ruff 1938). Frequently these concentrations are located on south facing slopes (Webb 1948).

As a result of topographical and cover requirements, only a percentage of the summer range can be used by deer in winter. Severinghaus (1951) found that only 12 to 13 percent of the fall range was used in winter in the Adirondacks. In Pennsylvania, McDowell (1950) found that all the deer using an area of good range were crowded into 10 percent of that area during bad weather. Even in southern climates, deer move to winter ranges. Schwan and Swift (1941) found range capacity in winter to be one third that of summer in Pisgah National Game Preserve in North Carolina.

In northern states, deer "yard" during periods of severe weather conditions. Yards are located in conifer swamps where heavy cover and food are available (Bartlett 1950). Deep snow is the primary determinant of yarding behavior (Taylor 1956). Though winter concentrations of deer occur in New Jersey, yarding is usually limited to periods of heavy snowfall, sustained low temperatures and high winds.

Webb (1948) found that north facing slopes produced the greatest amount of food and the least amount of cover. Level land and

south facing slopes produced a greater quantity of cover. Cover is the factor that determines the areas in which deer concentrate during the winter months (Taylor 1956). In general, sites used as winter range are warmer than surrounding areas, the shelter is better, the snow not so deep, and are generally located on the sunny side of the slope (Taylor 1956).

Cook and Hamilton (1942) found that many deer winter in young hardwoods, overgrown land, and orchards where the topography affords protection from the north and west winds. Many such sites exist on abandoned farmlands of northern New Jersey.

Wintering areas in northern New Jersey generally contain evergreen cover such as hemlock, rhododendron, and mountain laurel. In central New Jersey, where hemlocks and rhododendron are not as abundant, young hardwood stands and dense tangles of honeysuckle (*Lonicera japonica*) and grape (*Vitis* spp.) are used, as are abandoned orchards on south-facing slopes. Young hardwoods and eastern redcedar (*Juniperus virginiana*) stands are also important. In southern New Jersey, aerial and ground surveys indicate that wintering areas are found in and adjacent to lowland sites. These areas are primarily Atlantic white-cedar swamps, hardwood swamps and pitch pine (*Pinus rigida*) lowlands (Burke 1976). Thick cover, generally on the south side of swamps, offers protection from northerly winds, is drier than the swamps and allows more sunlight and warmth to reach ground level. During periods of extreme cold and snowfall, deer move into the white cedar swamps and pitch pine lowlands where less snow accumulates at ground level (Burke 1990).

### **History of White-tailed Deer in New Jersey**

The history of deer in New Jersey begins with New Jersey's first known inhabitants,

the Lenape Indians. Although there is some evidence that "Paleo Indians" hunted and traveled through the East (Weslager 1968), Lenape Indians were believed to inhabit what is now New Jersey, approximately 7,000 years before the first European colonization (Robichaud and Buell 1973). The deer was an important animal to the Indian. The venison was used for food, the hides for clothing and shelter, the bones for tools and weapons, and the deer skin thongs for tying, securing and fastening (Sweet and Wright 1954). Day (1953) stated that the Indians studied animal-plant relationships and perpetuated equilibrium by rotating hunting activities within established territories.

The early colonists also found the deer useful as a source of food and clothing. As a result of lumbering, fire and agricultural activities, the colonists improved food and cover for deer by setting back succession and diversifying the habitat. However, deer did not flourish under these improved conditions due to over exploitation by white settlers and Indians, who began trading in venison hams and deer skins. Many colonists realized the plight of the white-tailed deer and attempted to establish laws that would protect them. As early as 1679, an act was passed to prohibit the export of skins from deer killed by Indians (Brewster 1911). Beginning in 1722, a series of laws was established to control harvest. Seasons were set, hunting methods were restricted and penalties established to punish those who violated the provisions of the various acts (Sweet and Wright 1954). Despite efforts to protect the deer, the population continued to decline as the human population grew and man's exploitation of the land intensified. Cook (1968) stated that deer were found only in a circumscribed locality in the southern portion of the State. From 1853 through 1902, various laws prohibited killing of deer on a county or statewide basis (Brewster 1911). By 1902, lack of hunting restrictions and ineffective law enforcement reduced the deer population to a few family groups in the

pine-oak woodlands of South Jersey (Howard 1972).

From 1902 through 1908, an Act of the General Assembly closed the entire State to deer hunting (Brewster 1911). During this period, the New Jersey Board of Fish and Game Commissioners decided to restock New Jersey with deer (Sweet and Wright 1954). In 1904, nineteen Virginia white-tailed deer and eight fallow deer (*Dama dama*) were released from Worthington Game Preserve in Warren County (Board of Fish and Game Comm. 1905). In 1905, eighty-three deer from the same preserve were released (Tillett 1963) and additional deer were purchased from Pennsylvania and Michigan and released (Howard 1972).

In 1909, the General Assembly established an annual open season on deer that has been held every year henceforth (Brewster 1911). Any violation of the deer regulations was punishable by a \$100.00 fine (Brewster 1911). The reported deer kill in 1909 was 86 deer and in 1910 increased to 127 deer (Board of Fish and Game Comm. 1911).

In 1911, forty seven deer were purchased from the Cleveland Cliffs Iron Company in Michigan and released in the southern part of the State (Board of Fish and Game Comm. 1912). Two years later, 50 more deer were obtained from the same company and released throughout the State (Board of Fish and Game Comm. 1914). Soon after the importation of deer from Michigan, Mr. Worthington, owner of the Worthington Preserve, Warren County, released his deer by removing the fences (Warren and Rulington 1937). In addition, several hundred deer of different species and subspecies were released from parks such as Allamuchy State Park in Warren County and Bordentown Park in Burlington County (Wright 1949). Restocking efforts proved successful and the deer population increased rapidly. As early as 1912, deer damage to agricultural crops was reported (Board of Fish and Game Commissioners 1913).



Law enforcement had a major effect on the restoration of the deer population. Without effective enforcement, the hunting restrictions and the restocking efforts would probably have been futile. Another early regulation that aided in restoring deer numbers was the restriction of shooting only antlered males. With the exception of a state-wide either sex deer season in 1915, harvests were restricted to bucks. The "buck law", modified in 1928 to permit killing of male deer with antlers at least three inches long, was designed to allow the population to increase. Although this law did contribute to population increases in many areas, it established a philosophy that would later hinder efforts to establish antlerless deer hunting and deer population control.

Due to restocking efforts, favorable habitat, effective legislation and law enforcement, the deer population reached carrying capacity in the "pine barrens" of southern New Jersey by 1935 and in much of northern New Jersey by the late 1950s (Howard 1972). The minimum fall, pre-hunting deer population was estimated at 176,059 animals in 1993 (Baker et al. 1994). With few exceptions, the State is presently supporting a deer herd either at or in excess of carrying capacity (Howard 1972).

## **DEER MANAGEMENT IN NEW JERSEY**

Deer were re-established in New Jersey by sportsmen-conservationists for the purpose of sport hunting. Since the "restocking period," the responsible agency (now the Division of Fish, Game and Wildlife) has been managing the deer resource for this purpose. Since 1909, a total of 1,070,076 white-tailed deer have been reported harvested by legal means (Appendix A). The non-reported harvest, illegal kill and accidental kill (primarily due to deer-vehicle collisions) have also been substantial. Roughly 4,000 (1.6%) of the 245,357

reportable accidents which occurred on New Jersey's roadways in 1988 involved deer. It is estimated that total number of deer-vehicle collisions exceed 8,000 incidents yearly. Appendix B contains the results of winter mortality searches conducted by the Division in selected areas of the State following the hunting seasons.

The first report of deer damage to agricultural crops was made in 1912 (Board of Fish and Game Comm. 1913). In 1917, a regulation was approved allowing farmers who had valid deer damage to acquire a permit to shoot any deer damaging crops (Board of Fish and Game Comm. 1918). In southern New Jersey, extensive deer damage to cranberry, blueberry and other crops was reported in 1937 (Board of Fish and Game Comm. 1938). Officials relied on the use of chemical repellents, fencing and diversionary food patches to keep deer from farm crops (MacNamara 1940), instead of recognizing the need to control deer numbers. The policy of issuing permits to shoot nuisance deer was also continued in extreme cases (MacNamara 1940). Between 1940 and 1949, three deer research projects were conducted dealing with deer damage, deer movement and means of reducing deer damage to agricultural crops. Again, wildlife officials failed to recognize the fact that the deer population had reached carrying capacity in many areas and that population control through a more extensive harvest (such as an either-sex hunting season) was warranted. In 1950, pressure from farmers and landowners in Essex, Morris, Somerset and Union Counties forced the Fish and Game Council to change their policy. In January of 1951, a limited either-sex deer season was held and 472 deer were reported killed during a two day season (MacNamara and Sweet 1951). Resistance to the season was apparent due to low hunter participation and posting of private lands (MacNamara and Sweet 1951). Population control through either-sex hunting was temporarily abandoned. Deer

damage complaints since 1966 are summarized in Appendix C.

By 1958, the deer population in many portions of northern New Jersey counties reached carrying capacity as evidenced by extensive damage to agricultural crops (Howard 1972). Due to the outcry of the farmers in this area and the fact that either-sex deer hunting had become an established management tool in other states, the Division of Fish, Game and Shellfisheries conducted investigations in 1958 and 1959 to assess the deer damage problem and the possibility of having an antlerless deer season. The conclusion was that the deer population of New Jersey was at or above carrying capacity and that control measures should be taken to relieve deer damage and better utilize the resource (Mangold 1967).

In 1959, a permit season based on a first-come, first-served basis was instituted in the northern New Jersey Counties of Bergen, Essex, Hunterdon, Mercer, Middlesex, Passaic, Somerset, Sussex, Union and Warren. A total of 10,868 permits were issued and 3,571 deer were harvested (Div. Fish and Game 1960).

To determine the impact of the season, no antlerless season was held in 1960. However on January 31, 1962, the first statewide either-sex season since 1915, was held (Tillett 1963). Although there was opposition to either-sex deer hunting by organized sportsmen, statewide either-sex seasons were continued through 1968 with the exception of 1965.

Between 1968 and 1978 the antlerless season did not receive Fish and Game Council approval in several South Jersey counties, despite the recommendations by the Bureau of Wildlife Management. The organized sportsmen of the New Jersey State Federation of Sportsmen's Clubs in South Jersey contended that the harvest of antlerless deer had been and would be detrimental to the deer resource (6 members of the 11-person Fish and Game Council

represent the Federation of Sportsmen's Clubs).

In 1979, however, the Council agreed to open the entire state (except a small portion of Zone 22) for the shotgun permit season. All deer management zones were open for an either-sex shotgun permit day in 1981; and in six zones the season was expanded to two-days in order to attract more hunters and compensate for low hunter success rates.

### **The Deer Seasons**

As stated earlier, the deer resource in New Jersey has been managed primarily for the purpose of sport hunting. Appendix D summarizes some important regulations and aspects of white-tailed deer history in New Jersey by year. Appendix E lists the deer season hunting dates since 1909. From 1909 through 1946, hunting was generally restricted to hunting antlered bucks with shotguns. Beginning in 1947, the Fish and Game Council expanded sport hunting by allowing the use of bow and arrow to hunt deer. In 1949, a separate bow and arrow season was held for antlered bucks. Deer of either-sex were made legal game in 1952. Archery deer seasons have been held each year henceforth. In 1984, the first Extended Fall Bow season was held in Zones 13, 36, 49, 50 and 51. The number of zones in which an Extended Fall Bow season was held was increased in 1985. The Extended Fall Bow season was replaced by the Permit Bow season in selected zones in 1986. In 1993, the Division implemented a "Bonus Deer Tag" Program during the Fall Bow season in zones 7-13, 39, 40 and 41. The "Bonus Tag" allowed for the taking of one additional deer during the season, and was provided to hunters who harvested an antlerless deer *first* within the designated zones. By 1995, the Program was offered in 41 of 66 deer management zones. Since 1996, select zones have been designated as "Multiple Bonus Tag Zones" and hunters could harvest one antlerless deer per day from these zones

during the fall bow season. The season was shortened from 36 days to 24 days in 1996 to more equitably distribute the antlered deer harvest among all weapon type users. Beginning in 1997, the Fall Bow season in the suburban Zones 13, 36, 42 and 49 was 42 days, and hunters were required to harvest an antlerless deer before taking an antlered buck during the first three weeks of the season.

The first Permit Bow season was held in 23 of 54 deer management zones. The objective of implementing this season was to increase the antlerless deer harvest and to increase recreational opportunity. Deer of either-sex could be taken during the four week season. A total of 16,507 permits were issued and 1,768 deer were harvested during the first season. The season length has varied from three to four weeks based on other seasons, specifically the Six-day Firearm season. The Permit Bow harvest record of 7,327 deer was established during the 25-day 1996 season. The highest total harvest for a 19-day season was 3,992 deer in 1995 when 34,058 permits were issued. The "Bonus Deer Tag" Program was implemented in selected special areas (Earle Naval Weapons Station Depot and Supawna Meadows National Wildlife Refuge) beginning in 1994, for the purpose of increasing the antlerless deer harvest. The season length in zones 13 and 36, also known as the "Hunter's Choice Area," was extended through December 31 since 1994. Through the 1997 season, a total of 338,663 permits have been issued for the Permit Bow seasons.

In 1978, a separate, three-day season was authorized for muzzleloader rifle hunting. A total of 1,422 permits were issued and 249 deer were harvested during the first season. A muzzleloader season has been held each year henceforth. A second tag for deer with antler at least three inches long was approved in 1984. Since 1985, the second deer could be of either sex and any age. Season lengths have varied since 1978, but have been between 13 and 15 days since 1988. This season was established primarily to provide recreation, but now makes a significant

contribution toward reaching the antlerless deer harvest objective. Beginning in 1996, the season included two days prior to the traditional Six-day firearm season. A total of 29,736 permits were issued in 1997 and resulted in a record harvest of 9,831 deer, of which 69.3 percent were antlerless. Through the 1997 season, a total of 311,660 permits have been issued for the Permit Muzzleloader seasons.

The need to control deer numbers through either-sex firearm hunting or "doe days" resulted in experimentation with a variety of seasons. In 1951, a two day, antlerless deer season was open to all willing participants in a limited area in North Jersey. In 1959, a three day permit season was held, and a permit quota limited the number of hunters. In 1961, a one day, state-wide season was open to all deer hunters. During 1962, a "party permit" season was held. Four hunters could obtain one permit and harvest one antlerless or either-sex deer during the regular firearm buck season. This system was continued in 1963. Since 1964, either-sex seasons have been held on a permit basis. This system limits the number of hunters and the harvest of antlerless deer. By utilizing a quota system for issuing permits based on minimum population estimates and past hunter success, harvests are controlled with a high degree of accuracy. The shotgun permit season was later expanded from one day to two days in six zones in order to attract more permit applicants and compensate for low hunter success rates. In 1984, the Shotgun Permit season was expanded to three days and the bag limit was increased to two deer in Zones 9, 13, 14, 41, 50 and 51. In 1987 additional permits for special seasons could be purchased in zones which had unissued permits. In 1997-98 Permit Shotgun season format was: 12 zones had a one-day, one deer season; 9 zones had a three-day, two deer season; 12 zones had a seven-day, three deer season; 4 zones had a sixteen-day, four deer season; 12 zones had a twenty-two day, five deer season; and, 2

zones had a twenty-five day, five deer season. Season lengths and bag limits varied for special areas. A total of 40,582 permits were issued and resulted in a record harvest of 17,941 deer. Since 1982, a total of 542,576 permits have been issued for the Permit Shotgun seasons.

The Winter Bow season was added in January 1976, and 190 deer were harvested. In 1984, a second tag for deer with antler at least three inches long was approved for the Winter Bow season. After 1985, the second deer could be either sex and any age. The harvest record was established in January 1997 when 1,141 were taken. Appendix E outlines the dates of the various deer seasons.

Another significant aspect of the deer seasons has been the continuation of the concept of "hunter's choice" in the developed areas of the State. Beginning in 1962, firearm deer hunters were allowed to kill deer of either-sex during the regular Six-day Firearm deer season in specific developed areas of the northeastern section of New Jersey. The objective of this program was to minimize conflicts between deer and man in areas where remaining open space is being lost or is too small to support a deer population (Burke et. al. 1976). The program was expanded in 1974 to the northern shore area. Zone boundaries in many zones were altered in 1994, and the Hunter's Choice Area was expanded to include a redefined zone 13. The 1994 Permit Bow season in zones 13 and 36 was November 12 - December 31, and ran concurrent with the Six-day Firearm, Permit Muzzleloader and Permit Shotgun seasons.

Other changes in the seasons include legalization of the rifled slug (1975) and muzzle loading rifle (1976) for firearm deer hunting. The second tag program was initiated to encourage hunters to report the first deer taken. It also provides additional recreation time to successful hunters without detriment to the deer herd. In 1980, the second tag program was instituted for the

Fall Bow and Arrow and the Six-Day Firearm seasons. The second tag program was instituted in the Permit Shotgun season in some zones in 1984. Also in this year, a second tag for deer with antler at least three inches long was approved for the Muzzleloader and Winter Bow seasons. In 1985, deer killed under the second tag during the Muzzleloader and Winter Bow season could be either sex and any age. Due to changes in the Permit Shotgun bag limits, the "Second Deer Permit and Transportation Tag" became the "Supplemental Deer Permit and Transportation Tag" in 1995. A total of 10,669 deer (17.9% of the total harvest) were taken on supplemental tags in 1997.

## **THE CURRENT DEER MANAGEMENT PROGRAM**

### **Mandatory Deer Checking System**

In 1968, the Bureau of Wildlife Management increased its research effort on white-tailed deer. One important aspect of the intensified research program involved changing the method of monitoring the deer harvest. Biologists were aware from field checks that significant number of deer were not being reported through the pre-paid, post card system which had been employed for many years (Lund 1974). Deer project personnel decided to look for an alternative means to get harvest information and to monitor the non-reporting to determine if a change in the reporting system was needed. A survey of other states indicated that a mandatory deer checking system would provide more accurate harvest information. Although the post card system of reporting deer kills was convenient for both the hunter and the biologist, field checks between 1968 and 1971 indicated that at least 26.0 percent of the successful deer hunters were not reporting their deer (Burke 1975a). Based on the experience of other states, the Bureau's dissatisfaction with the post card reporting

method and a need for biological information statewide, the mandatory deer checking system was recommended to the Fish and Game Council (Lund 1974).

The Council agreed with the proposed change and a network of mandatory deer checking stations was established for the 1972 deer hunting seasons. Implementation of the system in New Jersey resulted in a 42.2 percent increase in the 1972 firearm buck harvest (6,972) over the 1971 total (4,904) and a 31.0 percent increase over the prior ten year average (5,333) (Lund 1974). Surveys of gun clubs, cold storage lockers, etc. indicated a high level of compliance with the new regulations. The system also enabled Division personnel to increase collection of information on the deer resource.

### **The Deer Management Zone Concept**

At the time the mandatory deer check station system went into effect, a new method of recording the exact location of each deer killed and related information was established. The state was divided into 637 deer management units, each containing 14.16 square miles. At the check station, the exact location of kills and related condition and productivity data was recorded and ascribed to a management unit.

Over 400,000 information items were collected at mandatory deer check stations in 1972 and in 1973 (Howard 1975). Utilizing personal computers, biologists combined data collected at the check stations with information obtained from other research projects. The result was the first meaningful change in deer management since the establishment of either-sex harvests as a management tool in the late 1950s (New Jersey Div. Fish, Game & Shellfisheries 1975). Areas with similar herd characteristics, land ownership patterns, land use, land use trends, soils and vegetation were consolidated to form thirty-six deer management zones varying in size from 90 to

344 square miles bounded by highways, rivers and other easily identifiable landmarks. Deer management zones have been added and modified since 1974. In 1997, there were 67 different deer management zones. Locations of these zones by boundaries are presented in selected sections of the annual **GAME CODE Regulations** [NJAC 7:25-5.29(p)].

Application of the zone concept was made in 1974 during the special deer season (Howard 1975). Permit quotas for the either-sex deer season and all management factors related to the season were regulated on a zone basis rather than by county. One of the advantages of this system was population control dictated by the needs and characteristics of the deer and their respective ranges (New Jersey Div. Fish, Game & Shellfisheries 1975).

Prior to implementation of the zone concept, either-sex permit quotas were made on a county basis where vast differences in deer population and range conditions existed, and county boundaries were often indistinct to a hunter in the field. Desired either-sex permit harvests were much harder to control by area under the county system, because hunting pressure could not be directed to specific areas.

The deer management zone system is an important aspect of this management plan and will be discussed in the following chapters.

### **Public Education Program**

Another important aspect of the deer management program has involved gaining public acceptance. Beginning in 1970, the Division of Fish, Game and Shellfisheries increased its efforts to reach sportsmen and the general public with information designed to gain support for programs, particularly the program for the harvest of antlerless deer in southern New Jersey. Information was made available through public forums, field trips, meetings, new releases, magazine articles,

personal contact and a variety of information leaflets distributed statewide. The result has been nearly total acceptance of either-sex deer hunting in areas of southern New Jersey. Specific information and education efforts have also been directed to the non-hunting public to gain general acceptance of the Division's deer management program and to refute growing anti-hunting sentiment.

### **Wildlife Control Policy**

Resolution of man-wildlife problems is an aspect of wildlife management that has been increasing, as the State loses more and more natural habitat to development, and as the human population increases. Each year the number of wildlife complaints the Division of Fish, Game and Wildlife receives increases. Division personnel from the Bureau of Wildlife Management and the Bureau of Law Enforcement investigate and assist in resolving man-wildlife problems. For example, the Division's Wildlife Control Unit received 586 deer complaints from agriculturists and homeowners in 1997 (Appendix C). The most frequently employed remedy for deer browse of ornamental plants is liquid deer repellent (NJ Div. Fish, Game & Shellfisheries 1975). 'Hinder' is presently the brand of deer repellent most commonly distributed by the Wildlife Control Unit. Fencing is available in limited amounts to qualified farmers experiencing damage to crops, and in some cases, a permit to shoot is issued (NJ Div. Fish, Game & Shellfisheries 1975). Fortunately, most farmers tolerate limited deer damage, and the harvest of deer of either-sex in recent years has maintained deer numbers at levels compatible with land use in most areas.

There are natural limits to the number of deer that a given parcel of habitat can support. This limit is referred to as the biological carrying capacity. However, the number of deer that humans are willing to tolerate must be considered. This tolerance

level is referred to as the "cultural carrying capacity" and is usually lower than the biological carrying capacity. It is defined by the number of deer damage complaints and the number of deer-vehicle collisions.

In spite of laws prohibiting the possession of wild animals, people persist in removing newborn fawns and other wildlife from the wild (NJ Div. Fish, Game & Shellfisheries 1976). In all probability, the fawn is not abandoned, but is left to hide, while the doe off feeding. It is the policy of the Division to discourage individuals from removing wildlife from its natural habitat (Howard 1975). Wildlife, especially deer, generally does not make good pets, and the average citizen can seldom provide for the deer's basic requirements (NJ Div. Fish, Game & Shellfisheries 1976). The Division adopted a formal "wildlife control policy" in 1975 (Toth and Howard 1975).

### **Community-Based Deer Management Plan**

Deer currently exist in suburban and other "problem" habitats at levels which exceed the cultural carrying capacity of the community. Traditional hunting programs have not been successful in controlling deer numbers in these situations due to high human population densities and associated perceived safety concerns; limited, fragmented, isolated or fenced deer habitat; local ordinances which prohibit weapons discharge; land closure resulting from liability concerns; political/philosophical opposition to hunting; and, limited or inadequate hunting efforts.

In an effort to assist local authorities in addressing suburban deer problems, the Division developed a community-based approach. Under this program, the Division will cooperate with municipal, county, state and federal agencies and other responsible entities (cooperator) to develop and implement alternative strategies for use in suburban environments where it has been

determined that traditional or controlled hunting programs are not an option or where hunting alone will not provide the desired level of reduction. Alternate methods include shooting, live capture/euthanize and relocation to an enclosed deer farm or facility. All costs associated with the use of alternative control methods are born by the Cooperator. The Division provides technical assistance in the development, implementation and subsequent evaluation of management programs. As of July 1, 1996, this study has been consolidated with other projects under the new grant title New Jersey Wildlife Research and Management W-68-R.

Since the beginning of the CBDMP program in February 1994, 20 municipalities, one private foundation and three county park systems were provided with information and/or assistance with their suburban deer control problems. Three Memorandums of Understanding (MOU) have been developed and signed allowing for the use of alternative deer control options as outlined in the CBDMP. These include the Morris and Union County park systems and the City of Summit (Union County). Discussions continue with a number of other suburban communities experiencing problems with expanding white-tail deer populations (Lund 1997).

### **Law Enforcement**

The Bureau of Law Enforcement in the Division of Fish, Game and Wildlife is responsible for enforcement of regulations designed to protect the deer resource. Unpaid civilian deputy conservation officers, concerned citizens, local police officers and other Division employees assist Conservation Officers in the enforcement of fish and game regulations. Enforcement efforts have resulted in a high level of compliance with the laws that protect wildlife. Although poaching and illegal activities persist and are important management considerations, the deer population has been maintained at a

level that has allowed for the annual harvest of deer through legal hunting since 1909.

### **Habitat Development**

Habitat manipulation to benefit wildlife is conducted on 98 State owned Fish and Wildlife Management Areas totaling 233,000 acres. Habitat management is encouraged on other public and private lands. Limited burning, wood harvest and planting of various agricultural crops increase the carrying capacity by increasing the quality and quantity of food available. In 1987, for example, 526 acres were planted in rye, hay mixtures, food patch mix, soy beans, wheat, corn, oats, buckwheat and lespedeza. Twenty-seven contract farmers who left 33% of their crop unharvested for wildlife food and cover on over 2,400 acres. Over 2,000 acres of permanent plantings were maintained and 2,000 tree seedlings were planted. The Bureau of Maintenance and Development selectively cut thirty seven acres of woodlands on land assigned to the Division (NJ Div. of Fish, Game and Wildlife 1987). Less than five percent of the land's administered by the Division are manipulated for the benefit of wildlife on an annual basis; and, on a statewide basis, habitat development has a minimal impact on the statewide deer population.

### **Cooperative Research and Management**

The Division cooperates with governmental agencies and private individuals in programs to manage deer populations. Cooperative programs have been conducted with Fort Dix Military Reservation, Earle Naval Weapons Depot, Lakehurst Naval Air Engineering Station, Picatinny Arsenal, the National Park Service, U.S. Fish and Wildlife Service, the Federal Aviation Administration Technical Center, State and county parks, and private game preserves. In addition to assisting in development of wildlife management plans or programs, controlled

deer hunts are designed to meet the specific needs of an area.

Cooperative research programs have been conducted with Rutgers University on the management of scrub oak (*Quercus ilicifolia*), estimation of the carrying capacity of deer in the pine barrens region, the nonreporting of deer killed by hunters, statistical analysis of data, wounding loss and general hunter surveys. Research conducted by Oakcrest High School and Stockton State College in Atlantic County monitored deer movement and mortality using telemetry equipment.

In addition to this research, many college students from throughout the State assist in check station operations, dead deer surveys and fawn capture activities (NJ Div. Fish, Game and Wildlife 1975).

## **PHASES OF DEER RESEARCH IN NEW JERSEY**

Between 1909 and 1945, the Board of Fish and Game Commissioners maintained records of deer harvests, deer related law violations, deer complaints, license sales, expenditures and other Board activities. These records were published in an annual report. In 1945, many state agencies were reorganized, and the Division of Fish and Game replaced the Board of Fish and Game Commissioners. The Division continued to keep similar records and published an annual report.

The first significant research on white-tailed deer in New Jersey began in 1940 and was jointly funded by the State and Federal governments. The 1940 research project and two subsequent projects started in 1945 and 1949, entitled "A Survey of White-tailed Deer Damage, Damage Control Methods and Population Characteristics" also included historical, economic, biological and general information on the deer resource.

In the early 1950's, collection of age, condition, reproduction and census information increased under another jointly funded project entitled "A Population Evaluation of White-tailed Deer."

During August of 1955, a highly fatal disease of deer appeared in Morris, western Essex and northern Somerset Counties (Shope et. al. 1955). Several hundred deer died from epizootic hemorrhagic disease (EHD), a viral disease that occurs in the summer and early fall (Shope et. al. 1955). Joint research conducted by the Division and the Rockefeller Institute for Medical Research resulted in the discovery of this previously undescribed viral disease of deer (Shope et. al. 1955).

As the deer population of northern New Jersey increased during the 1950's, damage complaints increased and the need to control the deer population became more apparent. In 1958, the Division considered having an antlerless deer season. A census of the deer population was made in 1959, and wildlife managers concluded that the deer population was at or above carrying capacity in most areas of the State (Mangold 1967).

Collection of biological information continued through 1963. In 1964, the current project was initiated entitled "A Study of the New Jersey Deer Herd." The project is jointly funded by State license fees and Federal taxes on sporting arms and ammunition. Through the years, this project has included a wide variety of research programs on white-tailed deer, such as the *Annual Deer Mortality; Condition and Productivity; Population Inventory; Collection, Evaluation and Dissemination of Deer Resource Information; and, Community-Based Plan for the Management of Suburban Deer Populations*. In fiscal year 1997, a new project entitled "New Jersey Wildlife Research and Management (W-68R-1) was initiated. This project combined separate research projects relating to deer, turkey, upland game and waterfowl under one blanket and is the basis of present



management. Study Plan I, which pertains to white-tailed deer, will include the following research programs: *Annual Deer Harvest; Collection, Evaluation and Dissemination of Deer Resource Information*; and, *Community-Based Plan for the Management of Suburban Deer Populations*.

Additional research on white-tailed deer has been conducted by the USDA's Northeastern Forest Experiment Station. Little and Somes (1958) found that excessive deer browsing was eliminating Atlantic white-cedar from many swamps in the New Jersey pinelands region. Another study discussed the effect of deer on forestry practices in the pine region of New Jersey (Little et. al. 1958).

Cooperative research programs between the Division and Rutgers University are included in project W-45-R "A Study of the New Jersey Deer Herd."

Appendix F lists deer research projects and expenditures by year and study conducted by the Division of Fish, Game and Wildlife.

## FOOD HABITS

Estimates of requirements of browse by mature white-tailed deer range from two pounds per day (wet weight) per hundred weight (Gerstell 1938, Smith et. al. 1956) to as high as seven pounds (wet weight) per hundred weight per day (Swift 1946, Trippensee 1948). These requirements must be met to maintain good condition. It is especially critical that these needs be met in the winter months when extremes of weather, temperatures and the requirements of pregnancy place additional stresses on the animal.

Quality and quantity of browse items varies greatly according to season. Forest composition in different areas of the State determines the type of preferred browse species available. However, in winter the abundance of quality browse is reduced considerably.

Accessibility of browse is an important factor in nutrition of white-tails. In areas of chronic overpopulation, the large numbers of browsing deer gradually crop the available browse beyond reach or eliminate it. Sprouts and seedlings are nipped off close to ground level and an obvious browse line develops at the maximum height that the animal can reach. Not only must browse exist in an area, but it must be accessible to the deer.

During the spring and summer months, deer consume herbaceous growth as well as woody stems. Numerous herbaceous plants are sought after by deer in the northern and central areas including goldenrod (*Solidago* spp.), timothy (*Phleum pratense*), Bracken fern (*Pteridium aquilinum*), and sensitive fern (*Onoclea sensibilis*) (Sauer et. al. 1969). Sweet clover (*Melilotus* spp.) and jewelweed (*Impatiens* spp.) are also used.

Sauer (1969) found herbaceous growth to be important on plots in New York during the summer months. Herbaceous species may also be important in areas of New Jersey during the summer. Those areas under cultivation or recently abandoned produce numerous preferred herbaceous species. The counties of Hunterdon and Middlesex include locations where herbaceous plants form an important staple food item.

Woody plants have been shown to be of greater importance than herbaceous plants in the white-tail's summer diet (Webb 1959). Sotola and Kirkpatrick (1972) found poison ivy (*Rhus radicans*), greenbrier (*Smilax* spp.), and Japanese honeysuckle (*Lonicera japonica*) to be important summer food items. White-tailed deer readily consume shrubs such as smooth and staghorn sumac (*Rhus glabra* and *R. typhina*), thornapple (*Crataegus* spp.), shadbush (*Amelanchier* spp.), and dogwood (*Cornus* spp.) as summer browse. Leaves and succulent stems and twigs of these species are consumed (Cook 1946, Stegeman 1937). These shrubs are commonly found in stands of second growth hardwoods, e.g., farmlands that have been abandoned.

As a result of the availability of browse items in summer, deer tend to be selective in their feeding habits. With the profusion of plant growth, the animals can afford to choose favored items. Stegeman (1937) found red maple (*Acer rubrum*) to be preferred summer browse. Cook (1946) found sprouts of sugar maple (*A. saccharum*), gray birch (*Betula populifolia*), and white ash (*Fraxinus americana*) to be among the species most widely used in summer in areas which had been clear cut. Sprouts of these species have been shown to be much preferred over the more abundant seedlings of yellow poplar (*Liriodendron tulipifera*), red oak (*Quercus rubra*), chestnut oak (*Q. prinus*) and white oak (*Q. alba*).

The soils of northern and central New Jersey are excellent for food crops as well as forests. Resident white-tails also uses crops such as corn, soybeans, wheat, oats and rye that are produced to feed cattle. Deer also consume alfalfa and clover grown for hay during the summer. These crops, as well as strawberries, tomatoes, potatoes, pumpkins, cabbage, and orchard grown fruits supplement the diets of deer in northern New Jersey. They may, in localized areas, comprise a major portion of the diet.

Oak-pine woodlands in general heavily forest the southern region of New Jersey. For the most part, soils are less fertile and more acid than those in the northern part of the state are. As a result of soil differences, the composition of vegetation differs (and preferred browse species) from the northern areas. Lowland sites provide most of the available browse. Deer consume woody plants such as greenbrier, grape (*Vitis* spp.), shadbush, sassafras (*Sassafras albidum*), Virginia creeper (*Parthenocissus quinquefolia*), sweet fern (*Comptonia peregrina*), spicebush (*Lindera benzoin*), huckleberry (*Gaylussacia* spp.), blackberry (*Rubus* spp.), wild rose (*Rosa* spp.), scrub oak, post oak (*Quercus stellata*), blackjack oak (*Q. marilandica*), dwarf sumac (*Rhus copallina*), and blueberry (*Vaccinium* spp.). Sprouts of hardwoods such as tree oaks (*Quercus* spp.) and black gum (*Nyssa*

*silvatica*) are utilized during the growing season (Little et. al. 1958). Tree growth is rarely browsed except in newly burned areas or recently cut-over sites where woody growth is succulent (Little et. al. 1958). Herbaceous vegetation fed upon by white-tailed deer includes blue-flag (*Iris prismatica*), turkey beard (*Xerophyllum asphodeloides*), and numerous grasses, sedges, and ferns.

As winter approaches, the high quality accessible browse of the summer months becomes less available to foraging deer. Early in the winter, a marked increase in food intake has been observed in white-tails (Ozoga and Verme 1970). Following the increase, there is a subsequent decline in consumption and a change in feeding habits. Deer begin to use the warmer hours of the day for feeding and reduce browsing during the night and early morning hours. Quality browse is of the utmost importance in these months when survival depends on an adequate food supply.

Japanese honey suckle, greenbrier leaves, redcedar, and fruit and browse of sumacs have been found to be on the white-tail's list of preferred winter foods (Sotala and Kirkpatrick 1972). Where available, apple fruit is much sought after, even when it must be dug from under snow (Taylor 1956). Red maple, sugar maple, and striped maple (*Acer pensylvanicum*) are used heavily as winter forage in the northern areas. Eastern hemlock, mountain ash (*Sorbus americana*), and both black and yellow birch (*Betula lenta*, *B. alleghaniensis*) are consumed as winter foods (Taylor 1956). Shrubs such as shadbush, rhododendron, mountain laurel, willows (*Salix* spp.) make up a portion of the important winter browse items. A small percentage of the total quantity of winter foods is comprised of various grasses (Sotala and Kirkpatrick 1972).

Oak mast is heavily utilized in areas where it is available. Duvendeck (1962) stated that acorns were extremely important to white-tails. Deer fed a starvation diet of pitch pine

and oak browse could not survive without supplemental feeding of acorns.

In southern New Jersey, Atlantic white-cedar has been rated as the most important winter food. Lowland sites where Atlantic white-cedar is found are heavily used by white-tailed deer (Little et. al. 1958). A nutritional comparison of Atlantic white-cedar with northern white-cedar (*Thuja occidentalis*), a preferred winter food in more northern forests, showed that Atlantic white-cedar compared favorably with the northern type (Gould and Brown 1961).

Although lowland sites provide a small portion of the total area of southern New Jersey deer range, they provide the major source of winter food (Little et. al. 1958). In addition to Atlantic white-cedar, pitch pine sprouts and seedlings, deer in the southern region use red maple, and black gum. Shrub species appear to be of little importance (Little et. al. 1958).

Bramble and Goddard (1953) found scarlet oak (*Quercus coccinea*), white oak, black oak (*Q. velutina*), and chestnut oak to be more heavily browsed in Pennsylvania during the winter than bear oak. The same observations have been made on upland sites in southern New Jersey. Oak mast is important in the autumn, permitting the deer to build fat reserves to carry them into the winter months (Little et. al. 1958). Acorns, when available during the winter period, are an important source of food in southern New Jersey. Total mast production, insects and fall climatic conditions affect winter acorn availability. Quality of available browse has been mentioned as a limiting factor to white-tail populations (Gerstell 1938, Swift 1946 and Dasmann 1964). Amman et. al. (1973) pointed out the importance of high quality food to wintering white-tails.

During the winter, the requirements for maintenance become a critical factor as the digestibility of the available forage decreases. In general, deer survive the winter on an intake of close to or below the maintenance

level required for the animal to survive. If the quality of available browse is low, large quantities must be consumed to sustain the animal. The capacity of the digestive system becomes an important factor. In low nutrient diets, the quantity of food needed to fill the animal's energy requirements is larger than the digestive system can handle. Consequently, when deer are forced to eat a diet that is low in quality or digestibility, their energy intake is below maintenance level. It may be said that the deer are in negative energy balance (Ammann et. al. 1973).

Survival under these hard conditions is dependent on three factors: the magnitude of the negative energy balance; the length of time on the diet; and, the extent of accumulated body stores and high metabolic rate (Ammann et. al. 1973). Because of their smaller body stores, fawns are at a greater disadvantage than adults are.

Torgerson and Pfander (1971) studied digestibility of various food items and found the cellulose of herbaceous species to be highly digestible. Crude protein and crude fat levels were found to be important determinants of food quality. Robbins et. al. (1975) found that nutritive value of feed is dependent upon its chemical and structural composition interacting with the digestive and metabolic capacities of an animal. Short (1975) found mature grasses and twigs to be of low nutritional value because of their low digestibility.

Digestibility and nutrient content determine the quality of browse (Torgerson and Pfander 1971, Ammann et. al. 1973, Robbins and Moen 1975). Minerals such as calcium and phosphorus and crude protein and crude fat content have been found to be requirements for white-tails (McEwen et. al. 1957, Dietz 1965, Smith et. al. 1956 and Torgerson and Pfander 1971). In essence, white-tails require an adequate supply of high quality, digestible browse for survival, and are major determinants of range carrying capacity.

## MOVEMENTS AND HOME RANGE

The movements and the home range of the white-tailed deer are determined by a variety of factors. Among these are the size of the animal, distribution of the essential requirements, the effect of stimuli from the environment on the spacing of the animal (Moen 1973), bodies of water, vegetation, social behavior, geographic and man-made barriers, weather, sex, and age (Michael 1965). Although the deer is a large animal its home range is one of the smallest among wild ruminants (Moen 1973).

Compilation of data from capture and marking studies in Hunterdon County (January 1970 to July 1976) indicate the main home range size to be one square mile or less. A total of 179 deer were captured, tagged and recaptured in this study. The majority of both males and females, 68.2 percent (n = 122), were recovered within one mile of their original capture locations. Of the remaining deer, 26.8 percent (n = 48) ranged from one to eight miles and 4.5 percent (n = 8) ranged from ten to nineteen miles. One deer (0.6 percent) was captured 30 miles from the original release site.

A study of 27 radio-collared deer in the Pine Barrens of South Jersey, conducted between March 1973 and July 1978, indicated that home range sizes of fifteen deer monitored for more than one year ranged from 100-800 acres, with an average of 360 acres. All deer utilized lowland pitch pine or white-cedar during severe winter weather. "Core areas," ranging in size between 30-60 acres, were used extensively as cover or bedding areas within the home range (Burke 1978).

The general range size is the same for males and females; however, there is a greater tendency for bucks to disperse long distances. Studies of white-tailed deer in Texas show that bucks move further and range over larger areas than does (Michael 1965). Of the 179 deer which were

recovered in Hunterdon County from January 1970 to July 1976, 107 were males, and 72 were females; 57.0 percent of the bucks were recovered within a mile, 35.5 percent were recovered from one to eight miles, and 6.4 percent were recovered from ten to nineteen miles from capture site. However, out of the 72 females, 84.8 percent were recovered within one mile, 14.0 percent were recovered from one to eight miles, and 1.4 percent were recovered between thirteen and fourteen miles from original capture sites. Doe movement during the rutting period tend to be in large circles within their range, rather than dispersal out of the range (Michael 1965).

Weather also has an effect on the movement of deer. Studies in other states show that the summer range is one square mile. During the winter months, however, the white-tail's range becomes reduced. A consequence to the reduction of the home range in the winter, is rapid depletion of the available food supply. As soon as the weather gets warmer, deer disperse (Moen 1973).

Age also influences the extent of movement of deer. Until the age of two months, fawns barely leave the bedding area. They begin to accompany their mother at approximately two months. They remain within their home range, with their mother, at least until six months of age. The age for dispersal, if any, is from six to eighteen months (Michael 1965).

Studies at the Crab Orchard Refuge in Illinois indicated that dispersal is highest among yearlings, especially males. Their data showed that 22 percent of all the marked yearling bucks were killed outside the study area. Only 3 percent of marked yearling does were killed outside the study area. Comparatively, only 8 percent of the marked two year old bucks were killed off the study area. Each deer included in this section of the Crab Orchard Refuge study was observed on the study area the same year it was killed off the area (Hawkins et. al. 1971). The reasons for high dispersal rates in some age classes was not clear; however, it was

certain that lack of food or deteriorating habitat were not factors (Hawkins et. al. 1971).

## **POPULATION TRENDS**

### **Reproduction**

Studies in New York indicate that the cycle of testicle growth in the adult male deer begins in June and reaches a peak at the end of September. Sperm are present from September to February and 25 percent of the deer examined exhibited the greatest testicular volume in November (Cheatum & Morton 1946). Testosterone levels reach their peak during the last two weeks in November (Jackson and Hesselton 1973). The highest incidence of successful mating occurred during November 10-30 in these studies (Cheatum and Morton 1946). Examination of embryos collected between 1979 and 1985 indicates that the peak of the mating season in New Jersey occurs during the first three weeks of November (Appendix G). Embryos collected between 1951 and 1961 indicate that deer from the southern portion of the state breed slightly later than those from the northern part of the state (Appendix H).

New York researchers did not find sperm present in the fawn males examined; however, a study in New Hampshire with penned deer reported a successful breeding of a doe fawn by a 202 day-old fawn male (Silver 1965). Workers at the Crab Orchard National Wildlife Refuge in Illinois found evidence that male fawns may be fertile. Of 130 male fawns examined, 98.5 percent showed some spermatogenic activity. However, it is probable that the majority of these would never have reached full activity. Spermatozoa were present in the cauda epididymides of 36.9 percent of the fawns and these fawns were presumed fertile. Only 2 of 130 fawns had spermatozoa in the testicles indicating maximum

spermatogenesis (Hawkins et al. 1971). The presence of fertile males was attributed to the high nutritional level of the refuge area. The variation in the stages of fertility was attributed mainly to the age of the fawn. It appeared that those fawns born before June 25 in this study were able to mature and reach the spermatozoan state and possibly be fertile by January. Later maturation and the dominance of adult males would most likely reduce the possibility of fertile male fawns playing a major role in reproduction (Follmann and Klimstra 1969).

Studies on the behavior of penned female fawns in New Hampshire indicated that 73.3 percent had ovulated in their first year but seldom earlier than January (Silver 1965). An examination of harvested females in Ohio indicated that 75 percent of the 335 fawns had ovulated. Ohio supports large areas of productive farmlands (Nixon 1971). The period of receptiveness in all females lasts approximately 24 hours (Taylor 1956). If the deer is not bred successfully, the estrus periods reoccur at four week intervals until the breeding season ends (Cheatum and Morton 1946).

Although most are capable of breeding at the onset of estrus, the actual reproductive capacity (conception rate) in adults and especially fawns appears to be influenced by several factors including quality of habitat (Cheatum and Severinghaus 1950). The nutritional value of food is particularly important (Verme 1967). Studies in New York contrasted the Adirondack region and the southern area of the state. The south has a longer growing season and is more diversified than the Adirondacks. The percentage of successfully developing eggs was much higher in this more diverse southern area and the number of pregnant adult does pregnant in the south was significantly greater than those in the Adirondacks (92.3 percent vs. 79.9 percent) (Morton and Cheatum 1946). Nutritional studies of penned animals showed that productivity increased from 0.79 fawns per

doe in deer receiving inadequate rations to 1.55 in those on excellent rations. Yearling females were particularly affected by inadequate rations in these studies (Verme 1967).

Early studies in New Jersey were based on the examination of female reproductive tracts removed from deer taken during the Permit Shotgun season. Corpora lutea and embryos were counted. Differences were found in the reproductive rate of deer from North Jersey compared to those of South Jersey deer (Sweet and Wright 1954). Data collected in the early 1950's showed that northern adult does had an average reproductive rate of 1.90 embryos whereas southern adult does averaged 1.57 embryos (Mangold 1959). The incidence of pregnancy in northern fawn does was 47 percent for the period of 1952-54. During 1952-62, 1,184 adult does from northern counties (Monmouth County and north) were examined and found to have a reproductive rate of 1.79 embryos per doe. An examination of 468 northern female fawns gave a rate of 0.41 embryos per deer. In comparison, 395 adult southern does had a rate of 1.54 embryos per deer and 109 southern fawns had a rate of 0.31 embryos/deer (Mangold 1962a).

Deer herds in some areas of the south reached the carrying capacity of the range as early as 1935, whereas North Jersey experienced its peak late in the 1950's (Howard 1972).

Differences still exist between areas of the State (Appendix I). In 1997, yearling reproductive rates ranged from a low of 0.75 fawns per yearling doe in zone 47 to a high of 1.81 in zones 35 and 64. The statewide average was 1.42 fawns per yearling doe. Fawn reproductive rates ranged from 0.0 to 0.5, with an average of 0.29, while older does exhibited reproductive rates of 1.04 to 1.97, with an average 1.78 fawns per doe. This is a reflection of range conditions. Generally, deer with the lowest reproductive rates come from the Pine Barrens in the Outer Coastal

Plain, while does with the highest reproductive rates come from the agricultural areas of the Inner Coastal Plain.

One of the most dramatic examples of the effect of habitat improvement or food availability on reproductive capacity occurred in the Earle Naval Weapons Station Depot in Monmouth County. Range conditions improved in this case by an annual removal of deer by hunting. Between 1968 and 1973 the reproductive rate almost doubled, an indication that the herd was in much healthier condition. The estimated fawn crop in 1969 was 116 fawns produced by 122 females, a reproductive rate of 0.95 fawns per doe, compared to 1974 when 78 does produced 133 fawns, or 1.70 fawns per doe (Burke et. al. 1975). Between 1968 and 1980 the number of corpora lutea nearly tripled from 0.66 corpora lutea per doe to 2.00 corpora lutea per doe.

New York reported similar improvement. In the western area of the state a 1.60 embryo/doe ratio existed in 1939-43. Following antlerless seasons, the reproductive rate increased to 1.90 embryos per doe in 1947-49. In areas where no antlerless seasons were held and the population density remained unchanged, fertility declined. Allegheny State Park had a reproductive rate of 1.36 corpora lutea per doe in 1944 following overbrowsing and severe winter losses. Balancing the population increased the rate to 2.0 corpora lutea per doe by 1948 (Cheatum & Severinghaus 1950).

## **Productivity**

Studies in Ohio indicate that there is an 11.5 percent ova and embryo loss for all ages of white-tailed deer during the first three months of gestation. Precocial fawns experience the highest mortality of ova and yearling does lose the least. Apparently few

embryos are lost after the first three months of gestation (Nixon 1971).

The average gestation period of the white-tail is 199.4 days and the majority of fawns are dropped in the last week of May and the first two weeks of June (Taylor 1956). One study has shown that most adult does, including 75 percent of the yearlings in good range, bear twins (Nixon 1971). The sex ratio at birth, as indicated by literature from eleven states, is 117.2 males to 100 females (Taylor 1956). However, it has been found that fawn and yearling does carry significantly more male than female fetuses (Nixon 1971) and that highly productive prime-age does usually bear both sexes in fairly equal numbers or bear an excess of females (Verme 1967).

It is estimated that there is a 10-20 percent early postpartum loss of fawns primarily as a result of nutritive failures (Verme 1967). Studies in Ohio indicated a 21.9 percent decline from the prepartum fetus to doe ratio as determined from accidental kills. It also appeared from these studies that more postnatal male fawns die than female (Nixon 1971).

Several methods have been used to determine the annual productivity in New Jersey's deer herd; corpora lutea counts, embryo counts, fawn/adult does in the annual either-sex harvest and antler beam measurements.

The first method studies the solid bodies (corpora lutea) formed in the empty follicles created when the egg ruptures spontaneously toward the end of heat or estrus. The corpora lutea secrete hormones that play a role in subsequent follicle development and pregnancy. If the deer remains unbred, the corpora lutea begin degeneration 14-15 days following estrus. A count of the corpora lutea scars gives a measure of ovulation; however, they may not represent the number of fawns produced. Additionally, unruptured lutenizing follicles may be confused with the true corpora lutea of pregnancy. Studies have indicated that if ovulation incidence

equals 2.5 corpora lutea per doe, the actual conception rate (embryos) is 1.87 embryos per doe (Cheatum 1949). The utilization of corpora lutea counts alone may therefore give an inflated estimate of annual increment. Another problem involved with using the count of corpora lutea scars is the inadequate sample size of reproductive tracts in some parts of the state.

The second method consists of an actual count of embryos in utero. The collection period of reproductive tracts is during the second week of December during the either-sex hunting season. Some embryos may be too small to detect at this time. A more important source of under estimation utilizing this method may occur in the fawn age-class due to the delay in this class of the onset of heat and breeding. As with corpora lutea counts, the sample sizes may not be adequate.

The third method, used for the establishment of the either-sex quotas in New Jersey, derives a minimum increment number based on the number of fawns that actually appear in the either-sex harvest. The juvenile or fawn population is calculated from the ratio of fawns to adult females in the harvest. This provides a minimum estimate of both the annual increment and surplus population. A certain degree of hunting selectivity towards larger and therefore older deer may be present during the hunting season. There may also be zones within the state where hunting selectivity plays a greater role in the number of fawns entering the harvest than in others. Those deer lost to accidents, illegal kill, disease and starvation do not enter either the minimum increment or the harvestable surplus figure. In 1995, 1959 fawns and 1836 yearling and adult does were harvested giving a 1.07 fawn per doe ratio. Since 1980, the fawn per doe ratio has ranged from a low of 0.89 in 1980 to a high of 1.11 fawns per doe ratio in 1994 (Appendix J).

According to Severinghaus and Moen (1983), the average yearling antler beam diameter is a

good indicator of the productivity of a deer herd and can be used to predict the reproductive rates of female deer of different age classes. Sample sizes of antler beam diameters are sufficiently large in most parts of the state. Predicted reproductive rates derived from antler beam diameters have been used since 1986 and do not differ significantly from those rates obtained from ovarian and uterine analyses used prior to 1986 (Appendix K).

## **Census and Index**

### **Hunter Harvest**

Prior to 1972, all successful hunters were required to report their kill by a prepaid postcard provided with their hunting license. Hunters provided harvest information on the season, sex, antler points and location (township and county). Biologists and other workers obtained biological data samples from packing houses and gun clubs. In 1972, the mandatory deer check station system was initiated statewide. All successful hunters in all seasons were required to transport their deer on the same day killed to a check station to receive a possession tag. Information was collected relative to season, sex, age, antler development, weight, reproductive condition and locations (county, township, management unit and zone) and hunter related information. This system continues today.

### **Aerial Census**

Aerial census by aircraft was used as part of an experimental comparison between aerial count and roadside track counts in the spring of 1951 and 1952. A piper clipper flown at an elevation of 150' was used in Ocean and Burlington Counties. The plane followed 16 parallel line courses three miles long and 1/4 mile apart. A total of 5.17 square miles was censused in 1951, with 68 deer observed. The population was estimated to be 151 deer

on 11.48 square miles. In 1952, 5.43 square miles were flown giving an estimate of 160 deer on 12 square miles (Wright 1954).

Practical use of aircraft began in 1961. The census was taken with a Hiller 12-E helicopter and utilized the same random sample plots designed for the drive methods of 1959-60 (Wright 1961). In 1962, the number of plots was expanded to 166 (Wright 1962). Later census utilized the Bell G2A2 helicopter. Sample plots were covered systematically at an elevation of 100-150' at speeds ranging from 5-20 miles per hour, during periods of adequate snow cover (3-6 inches minimum). Two observers record the deer seen to each side and beneath the helicopter taking care not to overlap and count the same deer twice (Lund 1971).

Censuses of most of the 166 random plots were carried out in 1962, 1963, 1966 and 1971. In 1968, only Hunterdon County was surveyed. In 1970, new census plot photos and plot location maps were prepared for the six North Jersey counties censused in prior years. Plot photos and locations were also prepared for Passaic County raising the total number of plots to 177. Passaic County was censused for the first time in 1971 (Lund 1971). Between 1971 and 1984, the census areas were reduced to several plots in Hunterdon and special areas in Warren, Morris, Monmouth, Ocean and Burlington Counties. Aerial surveys were discontinued from in 1984.

### **Roadside Track Census**

The roadside track census method was designed and initiated in southern New Jersey (Camden and Burlington Counties) in the winter of 1950-51. Roads in the area were divided into a total of 158 mile lengths called base-lines and 64 were chosen randomly for the track counts. All trails crossing the sample base-lines were swept clean of tracks the evening previous to the count. Tracks were counted the following morning and the



trail followed to gain sight of the deer and to determine the distance of the point of observation from the relative base-line (Wright 1954).

Practical application of the technique was begun in 1951 in seven southern counties. Trails were not followed; instead, the population was estimated statistically (Wright 1954). The method was used almost annually through 1966.

### **Drive System**

One of the first areas where drives were used as a method of censuring deer was Lebanon State Forest, Burlington County. The drive method consisted of 16 sample block areas ranging from 90 to 366 acres in size. Four Civilian Conservation Corps crews consisting of 67-74 men each censured 3,500 acres or 16 percent of the sample area. Counters were placed completely around the sample block area and the rest of the crew advanced through the block driving the deer out past the counters.

The Division first utilized the deer drive system for estimation of deer population in April of 1959. The northern area of the state was stratified into six sections based on the 1958 legal deer harvest. Drives were made on 1/2 square mile study areas selected at random. Standers surrounded the outside perimeter of the area while drivers, 50 yards apart, moved the deer out of the area past the standers who counted them. The ratio of deer to the area driven was obtained and formed the sample base for the estimation of the population.

Today the Bureau utilizes the data collected at the deer check stations to calculate the population. The estimate is based on the age and sex structure of the harvest and the reproductive rate of the females harvested.

### **Thermal Scanning**

Recently, the use of thermal infrared scanning technology has emerged as a potential "tool" to inventory wildlife populations. In 1994, the Division began employing this technique using a Forward Looking Infra Red (FLIR) system mounted on a fixed-winged aircraft to obtain early spring deer population estimates at 12 sites (8 suburban, 4 rural) throughout the State. Three sites were surveyed twice and one site three times to obtain a measure of precision. In addition, two enclosed populations of known size were also surveyed.

In 1996, four suburban sites were surveyed with a FLIR 2000 F/V Infrared Imager mounted on a Bell 206BIII helicopter. Flights were conducted at a mean altitude of 750 feet at a speed of 60 mph. In post processing, each frame of video tape exposed during the flight was examined via video enhancement software and the deer identified, plotted and counted. The Global Positioning System locations were then transferred to a Geographic Information System map. The use of a helicopter as a platform for the FLIR unit allowed the census to be conducted at a lower altitude and a slower speed than possible when employing fixed-wing aircraft. Although the cost increase was significant, it is believed justified by the increased accuracy obtained.

This system has potential utility in censuring suburban deer populations where inadequate late winter snow cover frequently precludes the use of aerial/visual techniques.

### **Effect of Hunting on Sex Ratio**

Studies from eleven states indicate that the sex ratio at birth of the white-tailed deer is 117.2 males per 100 females at birth (Taylor 1956). The fetal sex ratio in New Jersey has been found to be about 105.4 males per 100 females or about 51.4 percent males (Mangold 1963). Hunting can influence the postpartum sex ratio considerably. In many states, including New Jersey, the male deer is

subjected to more intensive hunting pressure than the female. In New Jersey, females may be legally taken statewide during the Fall Bow and Winter Bow seasons. Females may also be taken by holders of a special permit in those zones with a Permit Bow, Permit Muzzleloader or Permit Shotgun season. Antlered males can be taken during these seasons, as well as the Six-day Firearm season. In 1997, females could be taken on 113 of the 120 potential days of the deer hunting season. Of the 59,551 deer taken during the 1997-98 hunting seasons, 46 percent ( $n = 27,211$ ) were antlered males and 41 percent ( $n = 24,325$ ) were females.

The statewide harvest ratio in 1997 was 119 antlerless deer for every 100 antlered deer harvested. In areas of the state where intensive antlerless seasons have been held over a period of years, females enter the harvest figures at higher rates than they enter the population at birth. Monmouth Battlefield State Park (zone 64) has had an Either-Sex Shotgun season since January 1991. In January 1998, antlerless deer were taken at a rate 2.7 times that of antlered males during the Permit Shotgun season. In Deer Management Zone 11, which is open for all six deer seasons, antlerless deer were still taken at a rate 1.3 times that of antlered males. In zones located in the Pine Barrens region of South Jersey, antlerless deer were taken at a rate of only 0.8 in Zone 18 and 0.4 in Zone 46. Although a greater number of females per total population are left as propagators in these southern zones, the rate of increase in the northern areas is greater due to the higher reproductive rate.

### **Effect of Hunting on Densities**

The most obvious effect of hunting is reduction in the numbers of deer that will be held over the critical winter period in any one area. Winter ranges are more limited in food supply than are summer ranges and will support less deer. Reduction of the herd before the wintering period, helps to protect

the winter range from overbrowsing and reduces losses to malnutrition.

Management programs that include removal of does as well as bucks can effect an overall reduction in the size of the herd if the rate of removal is adequate. Reduction is not possible through removal of males only, due to the polygamous nature of the male white-tail (Taylor 1956) and the fact that in New Jersey, the majority of the adult males are removed after the breeding season. The majority of deer management zones in New Jersey have been placed on a deer reduction program due to the intense conflict that exists with other land uses such as farming and urbanization.

### **Effect of Hunting on Deer Age Structure**

Data collected during the 1980 hunting season in New Jersey indicated that 81 percent of the adult males taken in the northern counties (Warren, Sussex, Passaic, Morris, Somerset, Hunterdon, Middlesex, and Mercer) were yearling animals. All individual counties in the north had yearling increments greater than 65 percent with several counties approaching 90 percent (Person 1981). This yearling increment was an increase from the early 1950's when the yearling harvest ranged from 64 percent in 1950 to 74 percent in 1953 for the northern counties (Mangold 1962b). The increase of younger deer in the population is the product of intensified hunting pressure resulting in the escape of few older males, and the balancing of populations with food supplies through antlerless hunting, thereby increasing the number of yearling males bearing antlers.

The southern counties had a significantly lower number of yearlings in the harvest than the north during the early 1950's. The percentage of yearlings ranged from 28 percent in 1950 to 40 percent in 1952. It was assumed that the difference between north and south was due in part to the inaccessible regions of the south, such as the cedar

swamps and pine thickets, and in part due to the poor antler development in the yearling age class (Sweet and Wright 1954). An increase in the percentage of yearlings has occurred in some southern counties. Atlantic County reported 43.6 percent yearlings in the 1980 harvest (Person 1981) as compared to 25.5 percent in 1952. The increase in the southern counties can probably be attributed to increased hunting pressure and slightly improved range conditions. However, the pressure is apparently not as intense as experienced in the northern areas. The southern counties are still significantly lower than the north with all southern counties except Salem running below 65 percent yearlings in their 1980 harvests.

The contrast of the northern and southern area age structures are further exemplified by recent zone data. The highly agricultural and heavily harvested Zones 5, 8, 10 and 12 had yearling male increments of 80 percent or greater in their 1997 Six-day Firearm, Permit Muzzleloader and Permit Shotgun harvests (Appendix L). In comparison, Zones 18, 20, 21, 23 and 24, which are located in the Pinelands National Preserve area of the State, had yearling increments ranged from 25.0 in Zone 23 to 57.1 in Zone 18. With the exception of Zones 27 and 42, the southern zones all had yearling increments below 70 percent in their 1997 harvest.

Data collected at Allamuchy State Park in 1974 and 1975 further demonstrates the effect of hunting on age structure. The Park was opened to public hunting for the first time in 1974. The Six-day Firearm harvest in that year consisted of 36.4 percent (16/44) yearling males and 45.5 percent (20/44) 2 1/2 year old males. This contrasted sharply with the 86.3 percent yearling males and 12.6 percent of the 2 1/2 year old males taken in the same season in Zone 8 (McConnell 1975a). The 1975 Six-day Firearm harvest illustrated that the initial hunt had removed the majority of older males in the park. The yearling males comprised 81.3 percent and the 2 1/2 year olds were 19.2 percent of the

harvest. These figures were comparable to the age composition of the herd in the remainder of Zone 8, with 88.6 percent yearling males and 10.2 percent 2 1/2 year olds in the 1975 Zone 8 harvest (McConnell 1975b). Since the initial hunt, the majority of the firearm deer harvested have been yearling males. Between 1984 and 1988, greater than 80% of the Six-day Firearm harvest has been yearling males. These figures are comparable to the Zone 8 harvest during the same time period.

## **Predation**

Although man is the only important deer predator in New Jersey, dogs - both feral and free-running domestic - may have some effect on the deer population. Deer mortalities involving dogs are common in New Jersey; however, the total number of fawn and adult deer lost each year is unknown. Deer floundering in deep snow are quickly exhausted and may fall prey to dogs. Does carrying fawns and young fawns may be particularly susceptible to dogs, although large does have been known to be successful in driving a single dog away from its fawns. Dogs may also cause losses indirectly by driving deer into automobiles, trains or bodies of water where exhausted deer may drown (Foote 1945). Pennsylvania estimates its losses to dogs are between 500-1,000 annually; and, Vermont considers dogs its fourth most important cause of mortality (Foote 1945). It is known that losses are intensified during periods of snow accumulation.

Coyote, black bear, and bobcat predation on deer may also occur, particularly on newborn fawns; however, the extent of predation by these species is not considered significant.

## **Malnutrition**

Malnutrition losses vary according to weather conditions, density of population as related to food supplies and condition of the deer going into the winter period. In periods of

high wind, low temperature, sleet or snow, deer tend to concentrate in protected areas such as valleys, on slopes with southern exposures and in sites offering coniferous cover (white-cedar, hemlock, rhododendron and laurel). If weather conditions remain unfavorable, competition for the available food at these sites becomes intense or available foods may not satisfy energy needs, and some deer, especially the younger animals, may starve. In the winter of 1971-72, deer concentrated in Dunfield Hollow and Rattlesnake Swamp wintering areas (Warren County), succumbed to malnutrition (Burke 1972). In January 1982, cold temperatures and high winds combined to push wind chill to fatal levels for many deer in poorer habitat areas such as the Pine Barrens of southern New Jersey. The adult buck kill dropped significantly for the 1982 deer seasons and did not begin to recover until 1984 in this region (Burke 1990).

Losses occur even during mild winters with no snow in areas where herds have exceeded the carrying capacity of the winter range. In 1973, 13 deer were found dead of malnutrition in known wintering areas in Atlantic, Burlington, Cape May and Ocean Counties (Deer Management Zones 23, 24, 26, 33 and 34) (Burke 1973). In 1974, deer died of malnutrition in the Great Swamp National Wildlife Refuge in Morris County (Burke 1974). In February 1975, two female fawns were box trapped in southeastern Burlington County (Deer Management Zone 24). Radio transmitter collars were attached to the fawns and they were released. They were monitored daily until movement ceased in April. The dead fawns were located and examined. Extreme malnutrition was determined as the cause of death (Burke 1975b).

Since 1970, Division personnel have conducted annual dead deer searches in known wintering areas, during the months of March and April. Mortality losses due to malnutrition have ranged from a low of 0 (1972, 1973, 1980, 1981, 1983, 1985, 1986

and 1989) to a high of 52 (1978). In the spring of 1996, six known wintering areas covering 1,210 acres were surveyed. Of the seventeen deer mortalities were discovered, seven were due to starvation. The record winter snowfall did not have a significant effect, due in part to the record deer harvest, which enabled the remaining deer to survive the harsh winter. A summary of dead deer surveys from 1970 to 1996 is presented in Appendix B.

### **Accidental Losses**

Based on available data, losses due to vehicle-deer collisions rank second only to the legal kill. From July 1986 to June 1987, a total 6,287 deer were removed from New Jersey highways, 1,553 were reported killed, but were not located, and 2,654 were recovered by citizens with permits to possess accidentally killed deer. This is considered a minimal estimate of roadkills. There are undoubtedly many deer that are able to move off the road and die elsewhere, or are never reported to authorities. A more realistic estimate of the annual roadkill loss is 10,000. Losses peak in October, November and December due to the increased activity of deer during the rutting period. A second peak occurs in May and June corresponding to the fawning period (Lund and McConnell 1974).

From 1965 to June 1989, an average of 2,837 white-tails were killed and recovered from New Jersey roadways. An average of 810 deer were missing from the reported location annually, since June 1970. Vehicles have accidentally killed a minimum estimate of 82,673 deer since 1964. This represents 14 percent of the total reported legal harvest from 1964 to 1988.

In addition to deer-vehicle collisions other mortalities occur when deer get caught on fences, collide with trains, are killed by domestic dogs, drown in swimming pools,

fall into excavations, collide with landing aircraft, or are chased into buildings.

### Disease and Parasites

Deer are hosts to several internal and external parasites. Ticks, lice, keds and nose bots have been found on deer examined from several habitat types. Ordinarily, these external parasites occur in low numbers causing only minimal irritation. However, herds in poor condition may harbor external parasites in numbers sufficient to cause constant irritation and dermatitis.

Although many species of ticks are found in New Jersey, only the black-legged tick (*Ixodes scapularis*) and the Lone Star tick (*Amblyomma americanum*) are known to be involved in the transmission of Lyme disease, with the black-legged tick being the more prevalent. Infected ticks carry the spirochete bacterium *Borrelia burgdorferi*, which causes the illness. Not all ticks carry the spirochete. When an infected tick feeds upon the blood of an animal, the spirochetes are passed into the deer's bloodstream. Deer do not become clinically ill, as their blood is a poor source of the spirochete (Telford et al. 1988). Transmission of the Lyme disease spirochete is via a bite primarily from larval and adult *Ixodes* ticks which have ingested the spirochete from the blood of its primary reservoir, the white-footed mouse (*Peromyscus leucopus*). Transmission through blood to blood contact has not been confirmed.

Internal parasites found in Jersey deer include: tapeworms (*Taenia* sp., *Moniezia* sp.), stomach worms (*Ostertagia* sp., *Skrjabinagia* sp.), brainworms (*Pneumostrongylus* sp.), lungworms (*Dictyocaulus* sp.), gullet worms (*Gongylonema* sp.), filarial worms (*Setaria* sp.), muscle worms (*Parelaphostrongylus* sp.), intestinal worms (*Capillaria* sp., *Oesophogostomum* sp.), and whipworms (*Trichuris* sp.) (McConnell 1974). The cecal fluke (*Zygotyle* sp.) and protozoan parasites (*Eimeria* sp. and *Sarcocystis* sp.) have also been

recorded for New Jersey deer (Mills 1975, 1977).

Most of these parasites cause irritation to the lining of organs and surrounding tissues, and the larval stages may cause slight damage as they migrate through various organs. The parasites are usually held at tolerable levels by the body defenses; however, they can build to high numbers during stress periods, causing debilitation and secondary infections such as pneumonia.

An important viral disease of deer in New Jersey is epizootic hemorrhagic disease (EHD). It can be a serious threat to local deer populations as mortality can be as high as 90 percent in affected animals. The virus causes extensive hemorrhaging of blood vessel walls throughout the body, due to a dysfunction of the blood-clotting mechanism (Halls 1984). Two epidemic outbreaks of EHD have been reported in New Jersey. In 1955, Shope identified EHD as the agent that caused the death of an estimated 700 deer in Morris, Essex, and Somerset Counties (Shope 1955). In 1975, EHD was again identified as the agent responsible for the death of an estimated 1,000 deer in Warren, Sussex, Hunterdon and Morris Counties (McConnell et al. 1976).

It has been shown that the biting gnat (*Culicoides variipennis*) is the principle vector involved in transmission of EHD. All documented outbreaks have occurred in late summer and early fall and ceased with the onset of heavy frost indicating involvement of an insect vector. The seasonal limitation probably accounts for the failure of the virus to become permanently established in new areas (Davidson 1981).

Deer developed symptoms 5-10 days following an experimental injection of the EHD virus. During the 1975 epidemic, infected deer became depressed, went off feed, and exhibited edematous and hemorrhagic conjunctivitis. The deer had elevated temperatures accompanied by mucoid diarrhea. Necropsy revealed both

petechial and ecchymotic hemorrhages throughout the internal organs and excesses of fluid in the body cavities and pericardial sac (McConnell et al. 1976).

Malignant catarrhal fever is a viral infection that reportedly caused the death of at least six deer at a roadside zoo in Ocean County. Surveys of surrounding areas failed to detect any mortalities in free-ranging white-tails (Roscoe 1991).

Cutaneous fibroma is an infectious viral disease characterized by warty growths on the skin surface. The growths can vary in diameter from 0.5 to 20.0 cm. and may be single or multiple. They are usually found on the neck, face, shoulders and legs. The tumors are ordinarily not malignant, however, metastases to the lungs has been recorded in Wisconsin (Koller and Olson 1971). Experiments have indicated that the tumors have a rapid regression rate and that probably only an occasional deer develops progressive and persisting fibromatosis which may interfere with eating and breathing, eventually causing death (Shope et. al. 1958). Debilitating fibromas that have turned to bone have been found in New Jersey deer (Roscoe 1975).

All warm blooded animals exposed to the saliva of an infected animal can contract the rabies virus, including deer. Although the raccoon strain of the rabies virus has been documented in white-tailed deer in New Jersey (Roscoe 1991), it is not a common occurrence due to the minimal contact deer have with this species.

Leptospirosis, caused by the spirochete *Leptospira* sp., has been recorded in New Jersey and is one disease in deer that can be transmitted to man. The disease can be chronic (causing nephritis), or acute. The acute form in experimental deer causes abortion, anorexia, weakness, anemia, hemoglobunuria, fever and death (Davis et. al. 1970). Chronic leptospirosis was identified in a white-tailed fawn from Morris County in 1975 which was removed during

the Great Swamp National Wildlife Refuge hunt (Mills 1977). Leptospirosis in man causes fever, vomiting, headache, meningitis and, in severe cases, renal failure.

Dermatophillosis is a bacterial disease found in New Jersey deer that is characterized by mild to severe skin lesions, primarily on fawns. The bacterium has been transmitted to the skin of wildlife rehabilitators who subsequently developed a mild transient poison ivy-like dermatitis (Roscoe 1975).

Brain abscesses in male deer are commonly associated with *Corynebacterium pyogenes*, which gains entry through lesions of the antler pedicel or cranial bone junctions. It is a result of antler development, antler shedding, and/or rut fighting. Circling and other neurological problems are common clinical manifestations (Davidson and Nettles 1988). This tends to make these cases seasonal between September and March, with most cases in the peak of the rut (November).

Japanese yew (*Taxus* spp.) branches, leaves and berries may prove lethal through heart failure when ingested in amounts exceeding 0.5 percent of the deer's total body weight (Kingsbury 1964). Yew poisoning as observed in deer in New Jersey is common and seasonal. In early spring prior to the emergence of herbaceous plants and leaves, deer browse on evergreen plants. If yew comprises a substantial amount of their diet, deer have been reported to die in their beds (Roscoe 1989).

A few cases of deer attacks on humans have been recorded in the State (Roscoe 1989). In one instance, an antlered deer that had sustained severe injuries in a recent rut fight, charged and injured a small game hunter, who killed the deer during the attack.

## **HABITAT**

### **SOILS**

New Jersey is divided into two geological regions by a line running from Perth Amboy to Trenton. The Appalachian province lies

to the north and the Coastal Plain lies south of the line (Sweet and Wright 1954). The Appalachian area varies considerably in relief, soil type and drainage (Robichaud and Buell 1973), and is composed of three physiographic sections: the Ridge and Valley, the Highlands and the Piedmont sections. Deer Management Zones 1-14 and part of Zone 36 fall into these sections.

The Ridge and Valley section constitutes 7 percent of the State's total land area (Sussex and Warren Counties; Zones 1, 2, 4, and northern Zone 5), and is characterized by resistant rock ridges (shales and sandstone) paralleled by valleys formed on softer limestone based rock (Robichaud and Buell 1973). The Callaraugus-Swartswood soil types found here are acidic and have low moisture retention powers. Higher ridges are particularly stony, thin, and droughty; however, stronger and finer texture types cover the gravel on lower ridges (Quackenbush 1955). The Palmyra-Squires soil types (derived from limestone) of the Kittatinny and Vernon Valleys are deep, well drained, and fertile and are among the most productive in the state.

The Highlands section occupies 12 percent of the total land area (Robichaud and Buell 1973) (Morris, Passaic, south Warren, east Sussex, west Hunterdon, west Bergen Counties; Zones 2, 3, 5, 6, 7, 8, 9 and the northern part of Zone 10). This section also contains parallel ridges and valleys, but the ridges are more massive while valleys have steeper slopes and are more narrow (Robichaud and Buell 1973). Most of the northern Highlands is forested. Large outcroppings of hard bedrock are prevalent (Zone 2 and north 6)(Quackenbush 1955). Marshy hollows are common in this area. The acidic and well drained Rockaway soil types are predominant in this area. Although the soil can be cultivated for hay and corn, the high amount of gneiss derived gravel is a disadvantage. The better quality southern Highlands soils are derived from limestone. The deep and well drained Washington soils

found in Zones 7, 8 and 10 are among the best in north Jersey. The Annandale soils (Zone 5 and western parts of 8 and 9) are excellent but tend to be stony on steep terrain (Robichaud & Buell 1973). Excellent production is obtained along the river valleys of the Highlands section, particularly, the Musconetcong and Pohatcong Valleys (Quackenbush 1955).

The Piedmont section, occupying approximately 21 percent of the State, is basically a gently rolling lowland region, although there are several ridge formations on the northeast section (Bergen, Essex, Union, Hudson, eastern Passaic, Somerset, southeastern Morris, south Hunterdon, Mercer, north Middlesex; Zones 10, 11, 12, 13, 14 and small sections of 8, 9, and 36). The eastern section of the Piedmont contains the Westersfield soils (Robichaud & Buell 1973). These soils are soft, mellow, easily worked and productive; however, they occur in Zone 36 where industrialization and urbanization has occurred to such an extent that few agricultural areas exist (Quackenbush 1955). The Whippany soils of the central section are poorly drained silts (Zones 6 and 9). The most common associated soils of the western Piedmont are the well drained and loamy Penn and the deeper, higher quality Norton soil types. The Norton soils occur in sections of Hunterdon and Somerset Counties (sections of Zones 8, 10 and 12).

The Coastal Plain, comprising approximately 60 percent of the total land area of New Jersey, contains two physiographic sections: the Inner Coastal Plain (Mercer, Middlesex, Monmouth, Burlington, Camden, Gloucester, Salem, Cumberland Counties; Zones 14, 15, 17, 19, 20, western 25, 27, 29 and 35), and the Outer Coastal Plain (small sections of Middlesex, Monmouth, Ocean, Burlington, Atlantic, Cape May, small sections of Cumberland and Camden, Gloucester and Salem; Zones 15, sections of 17, 20, 27, 29 and 35) (Robichaud & Buell 1973). The topography of the Coastal Plain is of low relief. Marshes, bogs and swamps are

supported on lowland areas with high water tables.

The Inner Coastal Plain has some slightly elevated areas and the associated soils are much more fertile than the sandy ones of the Outer Plain (Gleason & Cronquist 1964). The dominant Freehold-Collington soil types are excellent deep, well-drained soils (Robichaud & Buell 1973) supporting extensive truck and orchard agricultural practices (Zones 15, northwestern 20, northern 17, western 25 and 35) (Sweet & Wright 1954). Other important soil types of the Inner Plain are the Sassafras (Zones 14, 16, northwestern 18), Greenwich (Zones 27, 29 and 35) and Sassafras-Keyport soils (Zone 28). The latter are sandy and well drained in some areas but are slow draining where high in clay and silt.

The Outer Coastal Plain has a much lower percentage of clay in its soils and is very high in sand. Almost 2,000 square miles are made up of very sandy soils of low fertility (Robichaud & Buell 1973). The dominant Lakewood soil types are sandy, acidic and highly leached (Zone 21, 22, 23, 26 and 32). Other acid and sandy soils in this region are the St. Johns (Zones 22, 23) Sassafras-Hammonton (Zones 24, 26, 32, and 33) and Sassafras-Cape May types (Zone 34). There are limited areas containing the well-drained acid, Aura sands and silts (Zone 31).

## **FOREST TYPE**

The considerable variation in relief, soil type and drainage of the Appalachian region (Robichaud & Buell 1973), and the activities of man has affected the development of several forest types. It is estimated that 1 million acres of forest land exist in northern New Jersey and nearly all of this forest had been cut over at least once, and in some areas several times, by the War Between the States. Much of the area has been burned repeatedly (Buell et. al. 1966). Oaks have persisted through the periods of fire and cutting and

now dominate the forests of this region (Buell et. al. 1966). There are three distinct forest types found in the area.

The most commonly found is the mixed oak forest with its red, white and black oaks and occasional scarlet and chestnut oak. Other species associated with mixed oak forests include maple, ash, elm, birch and dogwood. The understory contains abundant shrubs such as blueberry, huckleberry and viburnum.

The hemlock-mixed hardwoods forest type occurs on the cooler and moister sites and on steep northfacing slopes leading to ravines and valleys. More than half of the large trees are hemlocks. Mixed hardwood species associated with hemlock include basswood, sugar maple, black and yellow birch. This forest type supports a scanty undergrowth due dense shade and the acidic soil conditions produced by dropped hemlock needles.

The most diverse and richest forest is the sugar maple-mixed hardwoods type, found mostly in Ridge and Valley section in the Kittatinny area. White, red and black oaks are commonly found associated with the sugar maple as well as beech, basswood, hickories, black and yellow birch, white ash, tulip poplar and red maple. Hophornbeam is the most frequent understory tree. This type supports a lush undergrowth of spicebush, witch hazel, and maple-leaf viburnums.

The chestnut oak forest occurs on the ridge tops, slopes and rock outcroppings of high elevations. Red, white and scarlet oak, sweet birch and pitch pine are associates. The most common shrubs include heaths, blueberries, huckleberry and laurel. The highest elevations support a sparse growth of pitch pine, with scattered thickets of scrub oak.

The Outer Coastal Plain area is characterized by pitch pine, a species dependent on repeated fires. In areas that are slightly elevated such as the Pinelands, the lack of natural firebreaks allows for the humus (Gleason and Cronquist 1964) and litter to be



burned. The exposed surfaces create ideal conditions for pine seedlings (Robichaud and Buell 1973). Pitch pines and less frequently, shortleaf pine, are found with post, blackjack or bear oak. Blueberry and heaths in particular, are common understory plants (Robichaud and Buell 1973).

In contrast to the sandy areas of the Pine Barrens, are the lowland areas of high water table along the coastline. These areas support extensive marshes, bogs and swamps. The swamp areas contain some nearly pure stands of sweet gum with willow and Spanish oak. The bog areas are dominated by Atlantic white-cedar and are found mostly along waterways in the Pinelands area and on the Cape May Peninsula (Robichaud and Buell 1973).

Median areas between the wet lowland sites and the dry sandy areas of the pine barrens exist mainly in the inner coastal plain surrounding the area. Oaks are the dominant vegetative type of these areas and the oak species and associates are influenced by the soil composition. The western and southwestern coastal plain area, containing more fertile soils, supports white, red and black oaks and beech. The understory consists of dogwood, ironwood and sassafras. The northeastern areas bordering the pine barrens and containing sandier soils than the western areas, support white, black, red, chestnut and scarlet oak. Heaths, laurel, blueberries, huckleberry and swamp azalea compose the understory. On very sandy sites, the American holly, spanish oak and sweetbay are found as part of the mixed oak forest (Gleason and Cronquist 1964) (Robichaud and Buell 1973).

The coastal dune areas support shrub thicket communities (Gleason and Cronquist 1964) composed of bayberry, shadbush, blueberry, sumac, American holly, black cherry and scrub oak. Sheltered moist areas of the sand dunes contain American holly, black cherry, red maple, red cedar, pitch pine, hackberry and sassafras (Robichaud and Buell 1973).

## Land Use Changes

Estimates of the number of Native Americans present in New Jersey at the time of colonization range between 2,000 and 10,000. Although their numbers were low by today's standards, the Indians significantly altered forest composition. Land was cleared for villages and cultivation, and fire was used to aid in hunting, travel and warfare (Day 1953). By the time that the first white settlers arrived in 1620, the Indians had cleared or burned many areas, especially the accessible river valleys (Robichaud and Buell 1973).

The Dutch and Swedes, and those that followed, did not find a vast expanse of virgin woodland as once believed (Robichaud and Buell 1973). However, the colonists soon intensified modification of the environment by clearing for settlement and agriculture, cutting timber for various wood products and burning (Robichaud and Buell 1973). Disturbance of the land accelerated with increase in habitation. For example, in 1726, the year of the first census, New Jersey's population was 32,442 and by 1784, had jumped to 149,435. Demand for wood fuel, lumber and farmland increased proportionately. Through the middle of the nineteenth century, wood was the only source of fuel and demand resulted in the forests being cut over at twenty to twenty-five year intervals (Robichaud and Buell 1973). Fortunately, the introduction of coal resulted in a reduced demand for wood fuel. Between 1860 and 1900, the forests began to recover, despite a rapidly increasing population (Robichaud and Buell 1973).

Human population growth between 1850 and the present resulted in a density that is the highest for any state (Appendix M). Much of the population increase was centered in areas of traditional growth such as the northeast counties (Appendix N). However, recent trends have resulted in the loss of prime agricultural lands and woodland. Since 1870, the total acreage of agricultural land has

declined steadily through loss to development or abandonment (Appendix O). Total acreage of land in farm production was nearly three million acres in 1870 and had declined to just one million acres by 1983 (NJ Agricultural Statistics 1988). In contrast, the total acreage of woodland has changed little since 1860 (Robichaud and Buell 1973). Reduction in the demand for wood products resulted in an increase in forest age and stand size. The total acreage of forest land was approximately 2,120,000 acres in 1956 compared to 2,069,819 acres in 1899. Abandonment of farmland has offset the loss of woodland to development (Robichaud and Buell 1973). A more recent trend indicates a decrease in forest land to 1,928,400 acres in 1972; however, 2,163,000 acres (54 percent of the land area) still has tree cover (Ferguson and Mayer 1974).

In general, the present land use trend is toward development (industry, commercial and residential) with a corresponding reduction in open space. New Jersey's human population, although not increasing at a high rate, is continuing to move from deteriorating inner cities and urban areas to suburban areas. Appendix P illustrates the minimum deer population and densities per county for 1972 and 1993. Appendix Q lists the total land area and undeveloped, potentially huntable area in each county. It should be noted that not all undeveloped land, such as swamps and marshes could support a deer population.

Fifty-two percent of New Jersey's land area is potentially huntable, with land being lost at a rate of one percent per year. Seventy-seven percent of this potentially huntable land was open to hunting in 1981. Hunting access was restricted on forty percent of the land on which hunting occurred (Herrighty 1983).

Public land acquisitions under Green Acres Bond Issues have preserved some open space. The "Coastal Area Facilities Review Act: and "Wetlands Act" have slowed development in coastal areas and the

"Pinelands Protection Act" has restricted development within a one million acre area of southern New Jersey. The Farmlands Preservation Bond Issue has provided money for the preservation of farm properties in their present state. However, new concepts such as "transfer of development rights", strengthening of water and air quality standards, and additional regional planning must be developed to preserve open space.

## **SOCIAL ASPECTS**

### **Consumptive Users**

#### **The Hunter**

The reasons that people hunt are as wide and varied as the backgrounds of those who participate in the sport. One thing remains constant: there is a compelling urge within a percentage of the population to engage in hunting activities. Many authors have studied this drive, but a definitive reason for its existence has yet to be found. Many theories have been forwarded on the subject of hunting. Ortega and Gasset (1962) maintained that hunting is a deep and permanent yearning in the human condition. It is not an urge to kill, but to once again be united with the natural world. Man maintains a certain disadvantage in the hunt, not fully utilizing all the methods at his disposal for obtaining prey. Instead of summoning all his abilities, he restrains his excessive endowments and begins to imitate Nature - that is, for pleasure he returns to nature and re-enters it (Ortega and Gasset 1962).

According to some authors, hunting is a basic part of the composition of human behavior. W.S. Laughlin (1968) stated that hunting is the master behavior pattern of the human species. Hunting has been cited as one of the primary bases for the evolution of cooperation and sharing in humans (Fromm 1973, Shepard 1973). Undoubtedly, the

activity had a profound effect on human evolution (Shepard 1973).

Hunting is a complex affair with roots too deep to be pulled up and examined. If a hunter is asked to explain his sport, he can no more rationalize hunting than he can describe emotion. His hunting is, and has always been, a conditioned instinct that is largely emotional (Madson and Kozicky 1963). Enjoyment of the outdoors consistently appears among the reasons given for hunting. This was found to be a major reason for hunting among hunters in Wisconsin (Klessig and Hale 1972) and Colorado (Schole 1973). Of secondary importance is the challenge and suspense of the hunt. Kennedy (1974) found the challenge to be a primary motivation for deer hunters in Maryland. Other studies have shown the challenge to be second or third most important reason for hunting (Klessig and Hale 1972, Schole et. al. 1973).

Surveys in several states, including Ohio (Peterle 1967) and Massachusetts (More 1970), have indicated that success is not a necessity for satisfactory hunts. These findings are comparable with studies that showed that procurement of food was not a primary objective for hunting (Sendak and Bond 1970) (Bevins et. al. 1968).

Of the 98,188 licensed resident firearm hunters in New Jersey in 1996, an estimated 82,271 or 83.8 percent hunted deer during the Six-day Firearm season (McConnell and Garris, 1997). Over 47,000 resident hunters were licensed to pursue deer with bow and arrow (Appendix R). Although the number of hunters represents only a portion of New Jersey's 7,730,188 residents, an estimated 1.6 million recreation-days of deer hunting were provided to licensed hunters in 1997. As many as 120 days of hunting opportunity were provided to hunters during the 1997-98 deer seasons. When pre-season preparation for deer hunting is considered, many more days were provided.

Research has also been completed on the composition of hunter populations. Generally, it has been found that the New Jersey firearm hunter is an urban white male, with a high school education or better (USFWS 1991). A majority of hunters are married (Klessig 1970, Peterle 1967), are employed in a skilled or semi-skilled profession (Schole 1973) and fall into the \$50,000+ income bracket (USFWS 1991). It is also likely that he was introduced to hunting by a member of his family prior to 21 years of age (Schole 1973, Applegate unpublished data). The largest percentage of hunters are between 25 and 35 years of age. Men in their thirties are usually established in a profession and have few outside commitments such as school or military service to keep them from hunting (Nobe and Gilbert 1970). Older age group participation may be lower because of the physical stresses involved in the sport (Schole et. al. 1973).

The statistics for bowhunters in New Jersey were compiled from 1975-76 and 1978-79 hunter surveys (McDowell 1980; Hawkinson 1979). Fall bow hunters at this time, fell within the \$15,000 - \$30,000 income group. Winter bow hunters were in a slightly lower income bracket, \$10,000 - \$20,000. New Jersey bowhunters tend to be younger than their firearm counterparts. The majority of the hunters were in the 21-30 age class. Most bowhunters are regularly employed on an hourly wage and own their own home. Educational experience is at least complete through high school, with 20% indicating some college training. A 1983 bow hunter survey indicated that less than 8 percent of all bowhunters hunt deer exclusively with a bow. This survey also indicated that 98.7 percent were male and that the average bow hunting experience level was 11.5 years (Burke et al. 1983).

A 1983 survey was conducted on muzzleloader hunters that received permits for the 1982 deer season. An estimated 6,414 permittees participated in 25,015 man-days of

recreation and spent \$780,000. Over 88 percent of the survey respondents reported using percussion type rifles and over 95 percent indicated they also hunted deer with shotguns and/or bows (Burke et al. 1983). The average age for muzzleloader hunter was determined to be 38 years in a 1980 survey (Burke et al. 1980).

A substantial proportion of New Jersey hunters have a relatively transient interest in the sport. Some 43 percent of those who begin hunting quit within ten years of initiation (Applegate, unpublished data). Hunters from rural areas are more likely to remain in the hunting population than their urban counterparts (ORRRC 1962). Also, blue collar workers are more apt to continue hunting than white collar workers (Applegate, unpublished data) are. An inverse relationship exists between the size of a community and the percent of participation in hunting by members of that community (USFWS 1972). It is felt that inaccessibility to hunting areas is a major determinant in this relationship.

### **Violations and Illegal Kill**

Associated with the existence of any deer herd is the possibility of unlawful action by a certain percentage of the human population. Title 23, the New Jersey Fish and Game Laws, expressly prohibits the taking of deer outside the regular seasons and provides the enforcement officer with criteria on which to prosecute violators.

Since 1960, an average of 288 convictions for violations of laws pertaining to deer took place annually. The trend of increasing apprehensions may be attributed to a stepped up enforcement effort, added personnel or changes in regulations such as the prohibition of hunting deer over bait implemented in 1971. (This is a common, traditional and easy-to-detect practice in the Pinelands region of southern New Jersey).

Conservation officers spend many hours patrolling at night to apprehend violators, as much of the illegal harvest is attributed to night hunting. The largest number of prosecutions between 1960 and 1988 involved possession of an uncased weapon followed by possession of a deer out of season. Hunting deer during a closed season was the third most prevalent violation. No data is available on the extent of the total illegal kill. In some states it is estimated that the illegal kill equals the legal kill (Herb 1990, personal communication).

### **Unretrieved Hunting Mortalities**

Associated with harvests of big game animals is a loss of animals that are not recovered by hunters. The words "crippling" and "wounding" have often been used in reference to deer which recover, or die and are not retrieved after being shot legally by firearm or bow hunters. Hunters may accidentally or intentionally harvest deer that are not legal because of sex or antler development. Such animals must also be considered in any study of unretrieved, wounding loss (Losch & Samuel 1976).

Many authors have studied the extent of unretrieved and illegal losses. Estimates of losses range from 5 percent (Welch 1975) to over 100 percent of the take home harvest (Deboer 1957, Welch 1975). Losch and Samuels (1976) state that "the most common faults of such studies is the failure to state how the loss was calculated, the method used to estimate the loss, the type of loss incurred, whether it was wounding or crippling, the weapon used, hunter density, the type of season (either-sex or one-sex-only), weather conditions during the hunt or even the species of deer hunted. Simple omissions of this type render many studies nearly worthless to others."

Tully and Gilbert (1957) cited five factors that were important to crippling and illegal losses. One of the most important

determinants was the type of season, e.g. bucks-only, either-sex, or two deer. The terrain and cover in the hunting area and number of hunters also enter into the picture. In the category of hunters was included their attitude and the type of weapon used. Existence of snow cover or adverse weather conditions influences the unretrieved loss. Strong law enforcement efforts may reduce this loss.

Losses sustained during a bucks-only season tend to be higher than those in an either-sex season (Costley 1948, Tully and Gilbert 1957, Deboer 1957, Welch 1975 and, Losch and Samuels 1976). Reasons for this are associated with accidental or intentional killing and abandonment of illegal does and fawns in a bucks-only situation (Deboer 1957, Welch 1975 and Losch & Samuels 1976). Losses of mule deer in Utah during a bucks-only hunt ran as high as 42 percent while losses in an either-sex hunt were 25 percent (Costley 1948). A study conducted by Lohfeld (1979) at Allamuchy State Park in Warren County in 1975 and 1976 obtained a count of the deer killed, but not recovered during the hunting season. Nine illegally shot deer (13 percent of the total losses during the Six-day Firearm season) were found. Only deer that were legally shot and then lost were found in the one day either-sex hunts.

Terrain that makes tracking difficult may affect recovery of wounded animals. The presence of snow aids considerably in tracking injured deer (Robinette et. al. 1977). Adverse weather conditions could conceivably deter a hunter engaged in tracking a wounded animal (Tully and Gilbert 1957).

Hunter density is sometimes considered to be inversely related to crippling (Robinette 1947, Downing 1971). Indications are the high hunter density increases the probability of one hunter finding another hunter's wounded deer (Downing 1971).

Legal weapons for deer hunting in New Jersey include shotguns loaded with rifled

slugs or buckshot, muzzle-loading rifles, and recurve or compound bows. Stormer, Kirkpatrick and Hoekstra (1979) found that the per capita wounding rate by archers was 1.5 times that by gun hunters. Langenau (1986) found that archery deer hunters were estimated to have retrieved 43 percent of the deer hit by arrows, while shotgun hunters retrieved 81 percent of the deer hit. Tully and Gilbert (1957) and Downing (1971) cited high archery losses. These results are subject to question because of small sample sizes and methods (Losch & Samuel 1976). On the other hand, Deboer (1957) and Severinghaus (1963) found unretrieved hunting mortalities to be less than 10 percent during archery seasons. Losch and Samuels (1976) estimate archery losses at 20 percent. On the opening day of the 1974 Six-day Firearm deer season, 1,173 deer were examined at sixteen select deer check stations throughout New Jersey. Seven-tenths of one percent of the deer examined exhibited arrow wounds.

Methods used to determine unretrieved loss by most authors on the subject are personal observation, field interviews of hunters and intensive field searches (Tully and Gilbert 1957). Losch and Samuel (1976) in a review of the state-of-the-art in unretrieved loss studies observed that techniques and findings varied widely among authors. Interviews and field searches appear to be the more accurate estimators of mortality (Hardin & Roseberry 1975). A post-hunt questionnaire sent to hunters indicated a 32 percent loss on the Crab Orchard National Wildlife Refuge (Hardin & Roseberry 1975). Searches carried out on the refuge revealed a 20 percent loss (Hardin & Roseberry 1975). Bartholomew (1965) also believed hunters overestimated losses. Wood et. al. (1970) found actual unretrieved losses to be higher than indicated by hunter interviews.

Observations by Nettles et. al. (1977) showed that traumatic injuries due to gunshot wounds and highway collisions are usually fatal and result in little chronic debilitation. Data was taken from necropsy records of

1,002 white-tails. Evidence of previous injury was present in 76 deer or 7.6 percent. The percentage of injured deer did not vary significantly according to sex, physical condition, or six month period associated with high or low hunting pressure. Thirty percent of the injuries observed were due to gunshot or arrow wounds (Nettles et. al. 1975).

Losses associated with deer harvests must be considered in proper deer management (Whitlock & Eberhardt 1956). Although deer are shot by hunters that are not retrieved, there is no evidence to suggest that there is a significant problem on a statewide, zone or local basis in New Jersey (Burke 1990).

### **Hunting Pressure**

The number of deer in New Jersey and their visibility to the hunting public make them one of the most sought after game species in the State. As the only big game species in New Jersey with an open season, all the big game hunting pressure is exerted on white-tailed deer. Because of the limited amount of space available and the large number of hunters, heavy hunting pressure does occur. This is especially evident on lands open to public hunting. In some areas, the aesthetic quality of the hunt may be adversely affected by crowded conditions.

Intense hunting pressure is the most efficient means of obtaining a satisfactory harvest. The largest harvests generally occur on days of highest hunter concentrations such as holidays and weekends. (Laramie & White 1964). Saturdays and holidays are the days of highest kill during all archery seasons and the Permit Muzzleloader season. Analysis of the Six-day Firearm and Permit Shotgun harvests show the greatest number of animals harvested on the opening day of the respective season. It is likely that the largest number of hunters are afield on the opening day of the Six-day Firearm season. The last

day of that season, a Saturday, showed an increased harvest, possibly associated with the number of hunters afield on that day. The firearm season in southern zones is more evenly distributed over the course of the week than in the north. Hunting pressure, hunting methods, number of deer and habitat types are reasons for this difference in distribution. The distribution of the harvest for the 1997-98 seasons is presented in Appendix S.

### **Non-Consumptive Users**

White-tailed deer are of value to hunters and non-hunters alike. There are an undetermined number of recreation days provided to photographers, students and those who enjoy nature, both those who hunt and those who do not.

A survey conducted in 1976 of 3,600 Michigan residents indicated that deer were of some importance to a majority of the respondents (Langenau 1976). From the results of the survey, it was estimated that 2.6 million people actively sought to observe or photograph deer during a given year. Of this total, 25 percent had hunted deer during the previous season. It is interesting to note that of all the users of the Michigan deer herd, 27 percent were opposed to hunting while among the non-users, the number opposed to hunting was 41 percent. The non-users were those respondents who had no contact at all with deer during the year (Langenau 1976).

There is every reason to believe that deer are also important to non-consumptive users in New Jersey. The visibility of the animals prompts people to engage in observation and attempts at photography. A good deal of money is spent in pursuit of photographing wildlife in New Jersey. Equipment and film are, of course, the major expenses, but transportation and time must also be factored into the total cost. The aesthetic appeal of the New Jersey white-tail is very high to

most. For many New Jersey residents, seeing a deer is a rare occasion. Urban dwellers sometimes drive many miles to observe the rural landscape and animal life that exists there. Glimpsing a deer enhances a trip in the country and just the knowledge that there are deer to be seen gives such people satisfaction.

As urbanization encroaches on deer habitat, the carrying capacity of New Jersey's deer range will undoubtedly diminish. The result of this encroachment will be a reduction in the deer herd. With increasing human population and a decreasing deer population, the value of an individual animal will rise. No longer will large numbers of deer be available for the enjoyment of the public. Consequently, a smaller number of deer will have to fill the recreational demands, resulting in the increased value of these remaining individuals.

## **ECONOMIC ASPECTS**

### **Economic Value of the Meat and Hides**

The economic value of the meat from the 1997-98 hunting season was over \$6.4 million. This value was arrived at utilizing the system for determining the market value of venison developed by Wilcox (1976). It was assumed that 45 pounds of meat can be taken from an average sized deer of 90 pounds. The value of each pound of venison was estimated to be equal to the average price of ground beef (\$2.39/pound). The value of meat, when determined from the retail value of venison from domestically raised animals, was between \$14 and \$38 million dollars (McNee 1983). The price of venison per pound ranges from \$5.45 for ground meat to \$13.99 for boneless cuts. These totals do not include venison obtained illegally, from road kills or on permits to kill depredating deer (farmers are allowed to keep one deer on depredation permits). Popularity of lean venison has increased among the general

public due to increased concern regarding fat consumption and increased availability of farm raised venison.

The value of a deer hides is approximately \$5.00 per hide; however only a small percentage of deer hides are sold annually. The potential value of hides is estimated to be nearly \$300,000.

### **Taxidermy**

The income to individual taxidermists is substantial and varies by geographic location and expertise. The average full-time taxidermist in New Jersey mounts approximately one hundred deer heads each year. The price range of mounts ranges between \$150 and \$350, depending on the size of the mount and the experience of the taxidermist. A shoulder mount might average \$250 in New Jersey (Wyant personal communication). Tanned hides can be made into jackets, gloves, purses and other items. With the hair on, a deer hide can be used for a rug. The forelegs with hooves can be made into gun racks, hat racks or lamp stands. The amount that is generated to the state's economy cannot be estimated as many taxidermists work only part time and not all taxidermists belong to the New Jersey Taxidermist's Association.

### **Protein Value**

One of the motivating factors of an individual hunting deer is venison. Since the average deer harvested in New Jersey provides forty-five pounds of meat, the diet of many families could be supplemented by the consumption of a single deer. Some families would eat the meat because they prefer it to commercially purchased meat. Others would eat it out of need. Whatever the case, sportsmen and their families do utilize the deer meat and it does help fill their protein requirements. A 3.5 ounce cooked venison roast contains 1.04 ounces of

protein, but only 0.07 ounces of fat (Halls 1984). A survey in 1975 indicated that 80 percent of the successful bow and arrow hunters and their families consumed their deer (Burke 1976).

### **Venison Program**

Between 1973 and 1982, The Division of Fish, Game and Wildlife made venison available to sportsmen's clubs and various organizations for group dinners. The meat was obtained from vehicle killed deer. During this time, the Division received annual revenues totaling \$81,936.75. An average of 12,551 pounds of venison was consumed annually by various groups. By 1982, there were many more requests for venison than could be filled. The Division began phasing out dead deer pickup duties in the fall of 1983. In 1984, NJAC 7:25-18.1 et seq. was amended to give police agencies authority to issue permits to New Jersey residents to possess vehicle killed deer for consumption. At present, groups requesting venison are put in contact with farmers having permits to shoot crop depredating deer.

### **Incidental Utilization**

Many fishermen and companies dealing in fishing supplies utilize deer hair from deer tails in the construction of fishing lures. Antlers and bones are sometimes made into jewelry and knife handles. Meat scraps and bone are also used as pet food in the home.

### **Deer Damage**

Depredation of farm crops, nursery stock and ornamental shrubs and gardens around private homes is a very serious and expensive problem in some areas of New Jersey. The major problems usually occur in agricultural areas where concentrations of deer and limited hunter access exist. A substantial

harvest of the herd by sport hunting helps keep the problem at a minimum.

When a commercial deer damage problem is reported to the Bureau of Wildlife Management's Wildlife Control Section, a Wildlife Control Representative investigates the situation. Repellents or fencing might be recommended. If the problem cannot be handled with repellent or fencing, and the damage is extensive and appears that it will continue, a permit is issued to the farmer to shoot any deer he sees in the act of damaging his crop (Howard 1975). This regulation has been necessary in some areas even though the deer are subject to an annual hunt. If the deer seasons were closed, the problem would expand and an increased number of shooting permits would have to be issued to farmers with legitimate complaints. The Division of Fish, Game and Wildlife handled 793 deer damage complaints in the fiscal year ending June 30, 1994. This represents a 25 percent decrease in the number of deer complaints from the previous year.

The relationship of the deer population to the habitat is important from other standpoints. For example, where deer populations have been high, over utilization of preferred food species has occurred. The result has been severe damage or loss of vegetative types in these areas. When vegetation is significantly modified, increased competition or loss of food and cover affects other wildlife species. Various examples of habitat deterioration due to deer overpopulation have been noted including: the Seneca Army Depot in New York (Hesselton et. al. 1965), the Kaibab North Plateau in Arizona (Trefethen 1967) and the Great Swamp of New Jersey (Vogt 1976).

In response to the deer damage problem in fiscal year 1997, 642 gallons of repellent were issued to individuals with deer damage complaints. Most of these individuals were homeowners experiencing damage to their ornamental shrubbery and backyard gardens. Either area repellents or taste repellents are



distributed. Fencing is an effective method used to control deer damage to agricultural crops, especially on smaller fields (5-10 acres). A total of 350 rolls of wire mesh and 100 rolls of barbed wire were distributed to commercial farmers and nursery owners who experienced deer damage to their crops.

The Wildlife Control Unit's fiscal 1997 budget included \$21,000 for fencing and \$12,000 for repellents (Holloway 1996, pers. comm.).

### **Deer-Vehicle Collisions**

The number of deer-auto collisions on the roads of New Jersey is estimated at 6-8,000 annually. The actual figure may be higher, because many roadkill deer are not reported. In addition to the underreporting, deer are often not killed immediately upon impact, but go off into the woods and die later. The value of meat lost through roadkills in fiscal year 1988 was estimated at \$285,795. Of the 6,000 to 8,000 deer-auto collisions each year, between 3,000 and 3,200 involve damage exceeding \$500.00 and must be reported to local law enforcement authorities and the New Jersey Department of Transportation.

Insurance companies surveyed in 1975 reported that property damage resulting from deer-vehicle collisions cost between \$600,000 and \$1,000,000 per year (McDowell unpublished data). In 1990, an average deer-car collision would cost the motorist/insurance company \$800. With an estimated 3,200 deer-car collisions reporting damage in excess of \$500.00, approximately \$2,560,000 of property damage occurs each year. The actual cost is probably over \$3 million. Disregarding the economic loss, the danger to man and deer is considerable. Although rare, human deaths have resulted from deer-vehicle collisions. Without a controlling agent, the number of accidents would increase considerably, as has occurred in Princeton Township, Mercer County. Since the discharge of firearms was banned in

Princeton in 1972, deer-vehicle collisions have increased six-fold from 33 in 1972 to 200 in 1986 (Schneider and Kuser 1989).

The Division of Fish, Game and Wildlife began phasing out dead deer pickup duties in the fall of 1983. All Division involvement in dead deer recovery ceased by March 31, 1984.. In August of 1984, NJAC 7:25-18.1 et seq. was amended to give police agencies authority to issue permits to New Jersey residents to possess accidentally killed deer for consumption. On October 1, 1984 the Division resumed picking up road killed deer, after a special appropriation was budgeted for this purpose from the State's general fund. As of July 1, 1990, the program was terminated due to budget cuts. Roadkill recovery and disposal became the responsibility of municipal, county and state road/highway authorities.

### **Division Expenditures and Revenues**

The deer research project budget for fiscal year 1998 was \$441,571. Appendix F lists deer research projects and expenditures by year and study, conducted by the Division of Fish, Game and Wildlife since 1940. Division of Fish, Game and Wildlife expenditures and encumbrances for fiscal year 1997 totaled \$14,646,256 of which \$5,709,411 (39%) was derived from the purchase of licenses and permits by deer hunters.

### **Hunter Expenditures**

Mangold (1965) determined that deer hunters spent nearly \$6,000,000 on their sport in 1964. The *1970 Survey of Fishing and Hunting* listed the average expenditure per big game hunter in the northeastern United States at \$122.53. Projecting this information, all New Jersey deer hunters spent over \$16,000,000 in 1970. The *1975 National Survey of Hunting, Fishing and Wildlife Associated Recreation* indicated that the average deer hunter

expenditures ranged between \$204.00 and \$228.00. Projecting this information, 134,429 licensed deer hunters spent between \$27,423,516 and \$30,649,812 in New Jersey in 1975. The *1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation* estimated that New Jerseyans spent over \$183 million on hunting nationwide. This total expenditure includes food and lodging, transportation and other trip costs, hunting and other equipment, as well as licenses and permits. An average \$1,953 were spent by each hunter.

### Chapter 3.

## ENVIRONMENTAL IMPACT OF THE PROPOSED ACTIONS

### HARVEST IMPACTS

#### Estimated Harvest

The anticipated harvest from the six 1998-99 deer hunting seasons in New Jersey will range from 64,000 - 71,000 deer. The breakdown of the harvest is anticipated as follows:

Fall Bow	11,300 - 12,500
Permit Bow	6,700 - 7,400
Six-day Firearm	10,300 - 11,400
Permit Muzzleloader	9,900 - 10,900
Permit Shotgun	25,400 - 28,100
Winter Bow	1,150 - 1,300

#### Season Framework

Six deer seasons have been proposed for the harvest of white-tailed deer during 1998-99 as follows:

Fall Bow	October 3 - October 30, 1998.
Permit Bow	October 31 - November 28, 1998.
Six-day Firearm	December 7 - 12, 1998.
Permit Muzzleloader	November 30, December 1, 14, 15, 19, 21-24, 26, 28-31, 1998 and January 1-2, 1999.
Permit Shotgun	December 16, 17 and 18, 1998 (and January 9-30, 1999 in some zones).
Winter Bow	January 1 - 30, 1999.

#### Bag Limit and Hunting Hours

In deer management zones which *do not* offer a bonus deer tag, the season bag limit is two deer per season or permit, except for those zones in which there is a one day Permit Shotgun season. Only one deer may be taken per day except: in deer management zones 16-19, 21-31, 33-35, 37, 39, 42, 43, 45-49, 51-53, 55-59, 61, 63, 65 and 66; where the supplemental tag (and bonus tag, if applicable) is valid on the date of issuance, provided there is an open deer hunting season in the zone.

Fall Bow	Two deer of either sex may be taken. Bonus Deer Tags will be available for most zones. Legal hunting hours are 1/2 hour before sunrise to 1/2 hour after sunset.
Permit Bow	Two deer of either sex may

30,349 permits	be taken per permit. Note: more than one permit may be purchased by an individual for zones where additional permits remain. Bonus Deer Tags will be available for most zones. Legal hunting hours are 1/2 hour before sunrise to 1/2 hour after sunset.
Six-day Firearm	Two deer having antler at least three inches long may be taken. Legal hunting hours are 7:00 AM EST to 5:00 PM EST.
Permit Muzzleloader 28,824 permits	Two deer of either sex per permit may be taken. Only one antlered deer may be taken on November 30 and December 1, 1998. Note: more than one permit may be purchased by an individual for zones where additional permits remain. Bonus Deer Tags will be available for most zones. Legal hunting hours are sunrise to 1/2 hour after sunset EST.
Permit Shotgun 41,341 permits	One deer of either sex may be taken per permit per day, except in those zones where the supplemental tag is valid on the date of issuance and in zones 38, 39, 56, 59, 64 and 66 where the daily bag limit is two deer of either sex per day per permit. Note: more than one permit may be purchased by an individual for zones where additional permits remain. Legal hunting hours are sunrise to 1/2 hour after sunset EST.

Winter Bow	Two deer of either sex may be taken. Bonus Deer Tags will be available for most zones. Legal hunting hours are 1/2 hour before sunrise to 1/2 hour after sunset.
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### Overall Impact

The Bureau of Wildlife Management's hunting season recommendations, combined with all other non-hunting mortality factors (including highway kills, illegal kills, accidental death, dog kills, damage control permits and other types of mortality), will maintain the population at or below the carrying capacity and at a density compatible with other land uses within the deer range.

By keeping the deer herd in balance with the habitat, the health and productivity of the deer population and quality of the range will be maintained. An annual harvest of the deer herd will reduce the depredation of farm crops, gardens and ornamental shrubs. The number of deer-vehicle collisions will decline as will the expense of the associated property damage.

Some wounding of deer will occur during the proposed seasons; however, available information indicates that incidence is very low. Examination of deer for arrow wounds on December 9 and 18, 1991 indicated that arrows had injured only 1.5 percent of 958 deer examined. Injury from deer-vehicle collisions is noted more often.

### IMPACT ON ENDANGERED AND OTHER PROTECTED SPECIES

There is no evidence to indicate deer hunters have been involved with the killing or wounding of any protected or endangered species in the course of the deer season, however, the possibility must be considered. Since white-tailed deer have no similarity in

size or appearance with any endangered or nongame species in New Jersey, the possibility of mistaking another animal for a deer is remote. The probability of a stray shot encountering an endangered or protected species is infinitesimal after considering the number of animals involved, habitats occupied, season and probability. The danger of deliberate shooting of wildlife other than deer during the season is a possibility; however, no instance of a rare or endangered species being shot during the deer seasons has been recorded.

The benefits from the proposed hunting seasons to a large number of people outweighs the remote possibility of killing or wounding an endangered or protected species. Continued strict law enforcement and sportsmen education programs will further reduce the possibility of such a violation taking place.

## **IMPACT ON HABITAT**

The proposed action will have some impact on the vegetation. Breakage of twigs and trampling of vegetation will occur as hunters move through woods and fields. Since the hunting seasons occur during the months in which annual plants have expired and perennial plants are in a state of dormancy, the physical impact of the hunters will be minimal. Visual damage will be short term and physical impact is not expected to extend into the following growing seasons. Construction of deer stands or elevated platforms in trees could damage some trees and be esthetically undesirable to some individuals. Use of portable, non-permanent tree stands and enforcement of existing laws can reduce this problem where necessary. Impact on agricultural crops will be minimal since most crops will have been harvested by the hunting seasons, or will be cover crops in early stages of development. Posting of property and enforcement of trespass laws

have minimized problems or land-use conflicts in the past.

A potential problem with lead shot exists since lead pellets ingested by migratory waterfowl have been known to cause lead poisoning, especially where hunter density is so high that the density of pellets is one per square foot (Smith 1972). Lead poisoning can occur in upland wildlife but there is no evidence available to substantiate this possibility. The density of lead shot due to the proposed hunting would be insignificant. Most of the buckshot pellets and all of the rifled slugs could be eliminated as a source of lead poisoning due to their size.

The harvest of 64,000 to 71,000 deer by hunters will reduce the depredation to farm crops, nurseries and ornamental shrubs. This will result in fewer deer complaints and reduce the expense of handling the additional problems.

Competition for food, and cover increases when several wildlife species depend upon or utilize vegetation that has been browsed by deer. The deer can eliminate most or all of the vegetation growing close to the ground when they become too numerous. The reduction in the deer herd will ease the competitive pressure among the different species and provide the habitat with an opportunity to improve or at least maintain its present level of production.

## **IMPACT ON HUNTERS**

The proposed action would have a positive impact on the deer hunting public. The six proposed seasons would make over one million man-days of hunting available. These days would provide ample time for all interested sportsmen to enjoy the recreation and relaxation that is associated with an outdoor hunting experience. There are many people who look forward to such opportunities, as well as the possibility of having a successful hunt. The food value is a motivating factor to some since a deer can

supply up to one third of the meat required by a family of three for a year (Wilcox 1976). The proposed action would create a favorable psychological impact on those who believe that hunting is a wise use of a natural resource.

The risk of injury must also be considered. A hunter could be shot accidentally or shoot himself or another hunter through negligence. Overexertion on the part of some hunters could result in heart attack. Although there is risk of serious accident, hunting is ranked far below many contact sports in terms of safety or the number of accidents involved compared to participant time. A continued Hunter Education program and good law enforcement should minimize the possibility of accident or injury. Appendix T illustrates the recorded accidents from 1914 through 1995.

### **IMPACT ON NON-CONSUMPTIVE USERS**

The proposed action may cause some people to avoid open space areas during the hunting season due to fear of injury. There is no evidence to substantiate these concerns. In fact, many parks and Wildlife Management Areas are utilized by fishermen, hikers, birdwatchers and campers at the same time and with no conflict.

Individuals who find the killing of wildlife species morally or emotionally disturbing and are opposed to hunting may view the proposed deer seasons as a violation of their personal values and suffer mental anguish as a result.

The hunting seasons will also temporarily reduce the visibility of deer through herd reduction and behavior modification.

### **IMPACT ON THE ECONOMY**

As indicated in Chapter 2, deer hunters have substantial expenditures for ammunition,

firearms, archery equipment, transportation, clothing and other special hunting items. In the course of the deer seasons, hunters do business with stores and restaurants located in the vicinity of their hunting area. These expenditures are especially important to the economy of small towns such as Chatsworth and Green Bank. If the proposed hunting seasons were not held sporting goods and recreation businesses would suffer loss of revenue.

The 11 percent Federal Pittman-Robertson Tax on firearms, ammunition and archery equipment is returned to the state to support approved research projects, habitat management and land purchases. For fiscal 1996, approximately \$2.07 million was apportioned to New Jersey under the Pittman-Robertson Act (Snyder, 1996 personal communication). If no action is taken, the recreation and sport hunting related industries will suffer severe losses, and the Division will have less money from the Pittman-Robertson tax to fund its programs.

### **IMPACT ON STATE ADMINISTRATION**

The cost of deer management in New Jersey was estimated to be \$132,837 between July 1, 1964 and June 30, 1965 (Mangold 1965). This total included: \$51,675 for the Deer Management Project; \$68,607 for law enforcement; \$11,555 for deer research and \$1,000 for administration. The total was approximately 7 percent of the Division's budget.

The cost for deer management in New Jersey for the period July 1, 1995 through June 30, 1996 was \$1,795,638.00. This total included: \$12,780.00 for deer research (condition and reproduction throughout the winter-spring period); \$15,423.00 for dissemination of deer resource information; \$416,368.00 for deer management; \$841,783.00 for law enforcement; \$119,798.00 for wildlife control relating to deer; and \$195,000.00 for central

services (administration and permit system). This represents twelve percent of the Division's \$14,570,417.00 expenditures for fiscal 1996. The budget for deer research and management in fiscal years 1997 and 1998 was \$484,771 in each year.

## **IMPACT ON ENERGY CONSUMPTION**

The deer hunter in New Jersey drives an average of 493 miles a year in the course of his hunting effort (*National Survey of Fishing, Hunting and Wildlife-Associated Recreation* 1991). Assuming an average vehicle mileage of 15 miles per gallon, a New Jersey deer hunter will use 7,395 gallons of gasoline.

State agents and law enforcement personnel drive approximately 300,000 miles per year on deer related assignments. The gasoline consumption would be about 20,000 gallons.

Channeling people to other forms of outdoor recreation would not reduce the consumption of energy. New Jersey is the most densely populated state in the country with approximately 1,031 people per square mile. Eighty-five percent of the people live on only 15 percent of the land. Open recreational areas are located a considerable distance from the densely populated areas because of the demand for the land and the high cost. Consequently people have to drive quite some distance to reach these areas. If deer hunting is not permitted in the State, it is probable that New Jersey hunters will drive to other states where hunting is permitted. The obvious conclusion is that it is necessary to drive a reasonable distance in New Jersey to participate in most outdoor recreation activities and discontinuing deer hunting would conserve very little energy.

## **IMPACT ON NEIGHBORING STATES**

The proposed deer seasons for 1998 will have no adverse effect on the deer herds of the neighboring states of Pennsylvania, New York, and Delaware as white-tailed deer do

not migrate (Lund 1975). Records show that some white-tailed deer tagged in New Jersey have turned up in Pennsylvania; however, the incidents are isolated cases and insignificant.

Approximately 2,800 non-resident firearm licenses and 1,975 non-resident bow and arrow licenses will be sold for the proposed 1998 hunting seasons. This will bring approximately \$477,500 to the Division of Fish, Game and Wildlife.

## **Chapter 4.**

### **MITIGATING MEASURES INCLUDED IN THE ACTION**

Measures that help reduce the adverse environmental impacts of deer hunting include the Hunter Education program, the Law Enforcement effort, and the Information and Education section of the Division of Fish, Game and Wildlife.

Beginning in 1955, hunter education courses were required of all juvenile hunters aged 14 to 21 years old. These courses covered both firearm and archery safety. In 1958, a separate course was required for juvenile bowhunters (ages 10-13). Beginning in 1972, New Jersey hunting regulations required that all eligible individuals (aged ten and older) applying for a hunting license must provide proof of a previous license or the successful completion of the appropriate hunter education course offered by the Division. Evaluation of the volunteer hunter education instructors and instructor training seminars are held annually. In fiscal year 1997, 402 hunter education volunteer instructors donated 18,101 hours of their time to certify 9,799 hunting and trapping students (4,649 students were certified for shotgun firearm licenses; 2,824 for muzzleloading rifles; 2,248 for bow and arrow; and, 78 trapping graduates). The goal of Hunter Education is to place a safe, responsible, knowledgeable and involved hunter or trapper in the field.

The curriculum stresses the sportsman's obligations to the resource, to landowners, to other sportsmen and to themselves. The success of the Hunter Education program is substantiated by the continued reduction of hunting accidents and adverse incidents, in spite of the continued loss of lands open to hunting and the resulting increase in hunter densities.

The law enforcement effort under Title 23 of the New Jersey Fish and Game laws not only helps to reduce the safety hazard and destruction of the habitat, but also minimizes the possibilities of any violations associated with hunting. In 1973, one of the most important safety regulations was enacted, that of requiring all firearm hunters to wear hunter orange.

The Information and Education section of the Division of Fish, Game and Wildlife and biologists on the deer project provide programs on New Jersey's deer management program to both the hunting and the non-hunting public. The basic concepts of population dynamics are the foundation of the educational effort. Through publications, articles, news releases, seminars, and radio and TV programs, these concepts are illustrated to the target publics. In addition, the economic and recreational importance of the deer resource to the citizens of the State the importance of habitat, and the effects of man's activities on the environment are emphasized. The role of hunting deer management is also an important part of the educational program. The beneficial effects of keeping the deer herd at or below the carrying capacity of the habitat and the wildlife conservation accomplishments provided by funds from hunting licenses and taxes on sportsmen's equipment are explained.

## **Chapter 5.**

### **UNAVOIDABLE ADVERSE EFFECTS**

Loss of the deer resource will be incurred during the legal harvest through unavoidable unretrieved loss, and through illegal activities. A reliable estimate of the number of deer harvested illegally in New Jersey is not available. The known illegal kill has averaged 150 deer annually. In some states, the estimate of illegal deer kills can exceed the legal deer kill.

Because there are few species present in New Jersey that might be mistaken for deer, incidence of accidental harvest of non-target species is slight. Aside from domestic animals such as cows, horses, and dogs, the only other large wild mammal that might be encountered in New Jersey is the black bear. Bears are unlikely to be confused with white-tails, but may be taken intentionally. Other species may be taken accidentally or intentionally as a result of deer hunting activity. Concerted law enforcement efforts should handle the incidence of intentional taking of other species.

Lead shot may accumulate in areas subjected to intensive hunting pressure. No evidence that deer ingest lead to any significant degree exists; however, birds, particularly waterfowl and gallinaceous species, have been known to ingest small lead pellets. The larger size of buck shot and rifled slugs makes the possibility of this event happening in upland areas is so unlikely as to be negligible. Scavengers feeding on deer carcasses may be more likely to consume these larger fragments, and may therefore be at risk.

The incidence of Lyme disease may be higher due to the number of hunters afield. Hunters are likely to encounter ticks while scouting or pursuing deer. It is also possible that a tick could crawl onto the hunter while he is field dressing the deer, or drop off in the vehicle. Direct contact between hunters and deer increase the potential for transmission of communicable diseases, such as dermatophilosis. The potential for acquiring rabies exists in saliva to blood contact with a

rabid deer. However, the probability that a deer will be carrying a disease of any danger to man, however, is so small as to be considered statistically insignificant.

Hunting activities will temporarily reduce the deer population in certain areas thereby making location of deer difficult for those who wish to observe and/or photograph them. Activities of hunters may cause deer to be more cautious and wary, and thus less visible to the public. This effect will probably be short lived (Behrend & Lubeck 1968). Lands that are usually open to the non-hunting public may be inaccessible during the hunting seasons causing distress and inconvenience.

Some segments of the population may be disturbed by the noise associated with the firearm seasons. Some individuals may be disturbed by automobile noises at early hours as hunters drive to the field. These disturbances are expected to be of minor consequence. The sights, sounds, and knowledge of hunting activities may disturb certain people who profess moral objections to hunting and killing and/or a fear of firearms.

Hunting activities may result in trespassing and acts of vandalism. Landowners will incur expenses due to vandalism and necessary posting of lands. Isolated cases of trespass and/or violation of landowner rights by hunters may cause some properties to be closed entirely to public use.

Some damage to farm crops may result from hunting activities. Hunting seasons fall after most crops have been harvested so that the damage should be minimal. Natural vegetation may be trampled or destroyed in localized areas due to heavy hunter concentrations or dragging of carcasses. It is expected that most areas will recover in the following growing season and lasting effects will be minimal. Some trees may be damaged or killed by the cutting of limbs, building of tree stands and gunshots by hunters. Most

trees will recover from these injuries and lasting damage is likely to be insignificant.

Hunting activities carry inherent risks to both hunter and non-hunter alike. However the risk to non-participants has been negligible. Regulations governing hunting activities will reduce the potential for accidents. There may be accidents involving firearms or bow and arrow, in addition to accidents caused by overexertion, stumbling, and falling out of tree stands.

Increases in any human activity (hiking, camping, fishing, hunting, etc.) may increase the volume of litter in streams, woodlands and other areas. The quantity of trash deposited on State lands and in rural areas may increase with the influx of hunters. Additional expenses may be incurred in removal of this trash.

## **Chapter 6.**

### **RELATIONSHIP BETWEEN SHORT-TERM USE OF MAN'S ENVIRONMENT AND LONG-TERM MAINTENANCE AND ENHANCEMENT OF ENVIRONMENTAL PRODUCTIVITY**

#### **SUSTAINED YIELD AND HARVEST**

A total of 1,070,076 white-tailed deer were legally harvested between 1909 and January 31, 1998 (Appendix A). The harvest of deer in New Jersey has generally been limited to taking adult males and, in recent years, numbers of surplus antlerless deer. The concept of limiting the harvest to a portion of the surplus allows for harvests to occur annually or on a sustained yield basis. Dasmann (1964) defines the excess of game above the carrying capacity of the environment as the "shootable surplus." This surplus, if not taken by hunters, would inevitably be removed by some other means,



such as deer-vehicle collisions, illegal shooting, disease or malnutrition. The short-term use of the deer herd by sport hunters will enhance the long-term maintenance of the deer herd by keeping it in balance with the range.

McCullough (1979) defined maximum sustained yield as the maximum average number of animals that can be removed from a population without leading to extinction. However, New Jersey manages its deer for optimum sustained yield. Optimum sustained yield is that yield which the population can sustain and that maximizes human benefits.

### **EXPENDITURES BY HUNTERS**

In 1996, over \$117 million were spent in New Jersey by resident and non-resident deer hunters in pursuit of their sport (*1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation*). The harvest of deer for consumption may ease the financial burden of providing food for some families. Although many hunters do obtain meat for their effort and investment, deer hunter expenditures are far greater than the value of meat obtained. A survey made in 1965 indicated that for each deer harvested, the hunters of New Jersey spent \$736.50 (Mangold 1965). The expenditure per deer harvested in 1996 was \$1,094 (*1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation*), McConnell and Garris 1993). In comparison, the value of the deer's hide and venison ranges from \$112 to \$634, depending on the cut of venison.

### **PITTMAN-ROBERTSON TAX**

The Pittman-Robertson tax on firearms, ammunition, and archery equipment provides money to states for support of their wildlife research project. In New Jersey, the funds from this tax have been used by the Deer Research Project in the investigation of the

epizootic hemorrhagic disease outbreak in 1975, herd population studies, herd condition and reproductive research, habitat development, mapping the extent of the remaining deer range and the capture and tagging of deer for age and movement studies. Monies from this source have also been used to develop habitat for various species, including deer.

### **EXPENDITURES BY THE STATE**

The State's cost of game law enforcement, administration, handling deer complaints and 25 percent of the cost of deer research comes strictly from the sale of hunting licenses and special permits. The general public does not contribute funds to the support of the Division of Fish, Game and Wildlife, with the exception of money donated to the Nongame and Endangered Species Project through the check off on line 37B of the State income tax form. The general public paid for the recovery of road-killed deer from the state's roads and highways. The Division's deer recovery program was terminated in 1990.

### **HEALTH AND PRODUCTIVITY OF THE DEER HERD**

The basic short-term principle to be followed in the proposed action is the reduction of the deer herd prior to the winter stress period, to a level below the carrying capacity of the range. The short-term procedure, conducted annually, will insure health and productivity of the deer herd and the vegetative habitat upon which it depends.

### **LOCAL BENEFITS**

The maintenance of the deer population at a level compatible with other land uses will limit the number of deer-vehicle collisions, and maintain the quality of the habitat for all wildlife species.

Landowners will directly benefit from the deer management program through the reduction of deer damage to crops and ornamental plants, as well as income from lands leased to hunting clubs.

Local economies benefit from the money deer hunters spend on food, supplies and gas. Many small communities have come to depend on this seasonal income.

Many sportsmen's clubs throughout the State own land. These land holdings are generally utilized a few weeks prior to, during and directly the hunting seasons. During the rest of the year, they function as valuable open space. If the proposed deer seasons were closed, land may be sold for development, thereby lost as wildlife habitat and open space.

## **Chapter 7.**

### **INVESTMENT AND IRRETRIEVABLE COMMITMENT OF RESOURCES**

#### **DEER HARVEST**

The irretrievable commitment of the resource from the proposed action will be 64,000 to 71,000 deer. This loss will be temporary since the fawns born during the following spring will replace these deer. It will be necessary to remove a minimum of 52,000 deer each year through sport hunting to maintain a balance between the deer population and their habitat. Should no action be taken, many of these deer would inevitably die from other means such as vehicle collisions, illegal hunting, disease or malnutrition. The habitat could be severely damaged due to overbrowsing of deer in a limited range.

The biological carrying capacity is the number of deer that a given parcel of habitat

can physically support. The cultural carrying capacity can be defined as the maximum number of deer that can coexist compatibly with local human populations (Ellingwood and Caturano 1988). In most areas of New Jersey, the cultural carrying capacity is lower than the biological carrying capacity. Excessive deer-vehicle collisions and agricultural or home garden damage all suggest that the cultural carrying capacity has been exceeded in most areas.

The total deer population in the State has fluctuated slightly in recent years. Some deer management zones have experienced significant increases of deer while others have had declining deer population due to loss of open space to human encroachment. The loss of open land and deer habitat to development has been at the rate of 11,000 acres per year; this is very significant when one considers that New Jersey's total land area is only 7,419 square miles (*World Book Encyclopedia* 1992).

### **COMMITMENT OF TIME AND MONEY BY HUNTERS AND STATE ADMINISTRATORS**

According to the *1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation*, a total of 107,000 resident and non-resident sportsmen spent 2.2 million days hunting deer in New Jersey, and expended a total of \$117,318,000 as follows: food and lodging (\$18,194,000); transportation (\$4,932,000); and, equipment (\$88,308,000). It is assumed that the total expenditures of sportsmen hunting in the State will increase substantially in the future.

The New Jersey Division of Fish, Game and Wildlife's Wildlife Research and Management budget (deer) for the fiscal year July 1, 1997 to June 30, 1998 was \$484,771 (Appendix F). The federal share provided \$363,578.25, funded with Pittman-Robertson taxes. The budgeted salaries of the four deer research biologists was \$185,267 and approximately

\$5,700 were used for transportation expenditures. In addition, approximately 140 Division personnel are assigned to work at mandatory deer check stations annually at a budgeted cost of \$34,000, and seasonal assistants are hired to work during the deer seasons at a budgeted cost of \$45,000.

## **Chapter 8.**

### **ALTERNATIVES TO THE PROPOSED ACTION**

#### **TOTAL PROTECTION OF DEER EXCEPT DAMAGE COMPLAINTS**

The total protection of the deer herd in New Jersey, except for damage complaints, would essentially mean no management. The results of no management have been well documented in wildlife literature, such as the situations in the Seneca Army Depot (Hesselton et. al. 1965) and the Kaibab North Plateau (Trefethen 1967). The problems that existed in and around the Great Swamp National Wildlife Refuge would be expanded throughout the entire State (Vogt 1976). The white-tailed deer has no significant natural predators in New Jersey. With the complete protection alternative, the deer population would continue to expand and habitat conditions would deteriorate in a manner similar to the classic examples of protected deer populations.

A deer's reproductive rate declines as its physical condition declines. However, deer in poor condition will continue to breed and have fawns. The population will continue to grow, but at a slower rate. Some people have suggested abandoning the hunting program in the hopes that the deer will limit their own numbers. This will not happen in most parts of the State because the deer population is not at the biological carrying capacity, but the lower cultural carrying capacity. The

reproductive rate will not begin to decline until the population reaches the biological carrying capacity.

### **COMPLAINTS**

#### **Crop Damage**

If no management effort is made to reduce the population, deer damage to farm crops, commercial nurseries and private ornamental shrubs would increase considerably. Consequently the expense of handling the deer damage complaints would increase as more materials and personnel for handling complaints will be required. Shooting permits (issued to farmers with substantial evidence of crop damage) would increase (275 - 350 permits are issued annually). At the present time, most farmers rely on the hunting season to limit deer numbers and minimize crop damage.

#### **Deer-Vehicle Collisions**

Deer-vehicle collisions would increase considerably, particularly in areas of high deer density such as Hunterdon, Warren and Sussex Counties. When Princeton Township (Mercer County) banned the discharge of firearms in 1972, the number of deer-vehicle collisions increased six fold in the fourteen years following the ban. Property damage, danger to human life and the complete waste of the deer would increase proportionally to the number of accidents, making this one of the most significant impacts of the complete protection alternative.

#### **Impact on the Hunting Public**

The complete protection of the deer herd alternative would have a seriously adverse effect on the deer hunting public. There has been an open season on deer in New Jersey

since 1909. Some individuals who have been hunting within the game laws may find the new restriction hard to accept and consequently become violators. Law enforcement efforts and costs would increase drastically. Hunters that accept the new restrictions may be distressed and suffer mental anguish at the loss of a life-long enjoyment, source of recreation and valuable meat.

### **Economic Impact**

Private enterprise would suffer significant economic losses if the proposed deer seasons in New Jersey were not held. Sale of firearms, ammunition, archery equipment, special hunting clothes and equipment would be far below previous years. The numerous small establishments that benefit each year from the hunters who flow into their vicinity during the deer seasons would also suffer considerable economic loss. An estimated \$183,188,000 was spent nationwide by State resident hunters in 1996 (*1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation*).

The reduction in the sale of hunting related equipment would also create a shortage of funds now available through the Pittman-Robertson Tax Federal Aid to Wildlife Restoration Program resulting in a cutback in wildlife research and management programs. This would have a negative impact on all wildlife species.

The Division of Fish, Game and Wildlife would lose over \$6 million in license and permit sales if the proposed deer seasons are not held (see Chapter 2). The New Jersey Division of Taxation would also lose significant tax revenue (sales tax on equipment, transportation, food/lodging, etc.).

### **Non-consumptive Users**

Should complete protection of the deer herd be adopted, the impact on the non-hunting public would be negligible. Many individuals would be unaware of the change in policy, unless they were directly affected by deer damage, such as farmers or other rural residents. Non-hunters who feel the killing of wildlife for sport is unjust and an infringement on their rights would be relieved and experience a sense of accomplishment in attaining their goal to stop hunting. More deer would be available for wildlife photography activities.

### **Habitat Damage**

If no effort was made to control the deer population, the habitat would deteriorate as the population nears and/or exceeds the biological carrying capacity. Preferred foods would be selectively eliminated and deer would have to depend increasingly on plants with lower nutritive value and poorer digestibility. The deer herd would eventually reflect this negative impact in decreased physical condition and reproduction. Size, weight and antler development would decline. The incidence of disease, parasitism and starvation of deer during the winter stress period would increase.

An over-browsed range would be detrimental effect to other wildlife species, through competition for the remaining food and cover resources. For example, structural changes in shrubs and small trees can lead to the altering of habitat conditions for many small birds that are ground and shrub nesters (Hooper 1969).

### **CAPTURE AND MOVE**

Capture and relocation of the annual surplus of deer is an unfeasible alternative to the proposed action for the following reasons: the number of deer to be removed on a statewide basis is too large for any known capture method(s); the financial expense

would be too great; and, there are no known areas within the State to relocate large numbers of deer.

Approximately 52,000 deer would have to be annually removed on a statewide basis to adequately control the population. Although deer are captured using box traps, immobilizing guns, drop nets and other methods, attempts at controlling big game populations by capture and relocation methods have not met with much success. Capture and transfer operations on relatively small, fenced-in areas such as Seneca Army Depot in New York, proved to be an inefficient and costly alternative to hunting (Hesselton et. al. 1965). Research conducted in Wisconsin resulted in capture costs ranging from \$113 to \$570 per deer, with an average cost of \$412 per deer (Ishamael and Rongstad 1984). Trap and transfer programs conducted in New Hampshire resulted in costs of \$800 per deer, and in California of \$431 per deer (O'Bryan and McCullough 1985).

Deer are susceptible to traumatic injury during handling. Losses attributable to trap and transfer programs average 4 percent. Delayed stress-related mortality is an often overlooked factor in mortality. Survival rates of relocated deer are frequently low. Trap and transfer efforts in California, New Mexico and Florida resulted in losses of 85, 55, and 58 percent respectively (O'Bryan and McCullough 1985).

## **BIRTH CONTROL**

The use of chemical reproductive inhibitors has been suggested as an alternative to the proposed hunting seasons. Reproductive inhibitors have been used with some success on domestic animals, but only experimentally on wildlife. Deer reproductive studies in Ohio and Kentucky showed poor results using oral dosages of diethylstilbestrol (DES), due to rejection by the deer (Matschke 1977). Intramuscular doses of DES significantly

reduced productivity in the Ohio study, but that reduction was insufficient to contain local herd growth (Harder and Peterle 1974).

The deer herd of New Jersey is free roaming throughout the State. Application of the inhibitor on a full scale effort would be extremely difficult and in most areas impossible.

Antifertility agents have been delivered remotely to feral horses via dart guns (Turner and Kirkpatrick 1988). Improvements in anti-fertility vaccines and remote delivery systems increase the possibility of use on white-tailed deer. However, at the present time, fertility control in deer is largely untested and requires additional research<sup>1</sup>. It may have value on small isolated populations of deer, but will not provide an alternative to hunting for the control of free-ranging herds (Kirkpatrick and Turner 1988). This alternative, however unreliable and untested, would be favorable to many individuals who oppose hunting (Ellingwood and Caturano 1988).

## **EXPERT MARKSMEN**

The use of a small group of expert marksmen to reduce the deer population in the State has been suggested as an alternative to a public season.

The precise number of hunters and the length of time required to accomplish the desired harvest is not known; but, an estimate has been made so that the financial burden

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<sup>1</sup> In fiscal year 1997, the first Special Permit to Inhibit Wildlife Reproduction was issued to the Humane Society of the United States and the Morris County Park Commission under Food and Drug Administration (FDA) Investigational Exemption for a New Animal Drug (INAD) 8890. The four year project will test the effectiveness of a new adjuvant for the PZP vaccine, confirm the tested form vaccine effectiveness in a two-dose initial vaccination sequence and evaluate PZP vaccine as a tool for the control of a small, semi-free-ranging population of white-tailed deer (Lund 1997).

can be interpreted. A group of one hundred marksmen would require six to seven months to harvest approximately 12,000 deer if each individual managed to kill one deer a day, which is a very high success ratio. The cost of salaries, equipment and transportation would probably approach one million dollars.

The disposal of the harvested deer would create another problem. One solution would be to donate the carcasses to charity organizations. The processing of meat would be approximately \$40 per deer or \$480,000 for the total harvest. Another alternative would be to dispose of carcasses through a rendering plant; however, that would be a waste use of the resource.

### **BUCKS-ONLY LAW**

The adoption of a bucks-only regulation, applicable to all deer hunting seasons, would be a step backward in the field of deer management. The buck only regulation would not be in the best interest of the deer herd. There are a certain number of antlerless deer that must be removed each year in order to control deer numbers and to keep the herd in balance with the habitat. This alternative would meet resistance from both the non-hunters and hunters.

### **EITHER SEX**

An either-sex regulation for all deer hunting seasons would not be a sound deer management practice. The harvest of antlerless deer is an important tool in deer management, but the number harvested must be regulated to maintain the population at desirable levels. This is why the permit system is utilized in the administration of the antlerless season. The implementation of the permit system provides the Bureau of Wildlife Management with a tool to scientifically limit the number of antlerless deer taken in each deer management zone. An open season on all deer would lead to an

unnecessary reduction of the total population. Some areas of the State could tolerate such a reduction; for other areas, it would be against the present goals of the deer management program.

This alternative would not be met favorably by many of the concerned interest groups. Those opposed to public hunting would strongly resist this alternative and the hunters would oppose reducing deer populations below present levels in many areas.

### **SHORTER OR LONGER SEASON**

The adoption of a shorter hunting season as an alternative action would be fruitless. It would cause a loss of recreation days and make it difficult to attain the required harvest figures. On the other hand, the lengthening of the Six-Day Firearm, Muzzleloader or Bow and Arrow seasons would provide additional recreation time without jeopardizing the welfare of the deer herd in some zones. It would provide ample time to assure the harvest of the desired number of deer. The only conflict might be with the other hunting seasons normally closed during the firearm deer seasons. There was no biological reason to prevent bow and arrow seasons from running simultaneously with the small game seasons. Permit bow seasons have been held this way since 1984.

Persons opposed to public hunting would strongly oppose any extension of the hunting seasons; on the other hand, they would probably favor a shortening of the season, feeling that this might be a step toward complete abolition of hunting. The hunters would oppose the shortening of the season because of the loss of recreation time. The extension of seasons would probably be favored by many of the hunters although some might oppose it because it would interfere with their other types of hunting or long standing philosophies.

## **REINTRODUCTION OF NATURAL PREDATORS**

Reintroduction of natural predators, such as wolves and mountain lions, has been suggested as an alternative to hunting. Although wolves or mountain lions could possibly re-establish themselves over a period of several years in limited areas, the cost of purchasing the predators from a state willing to live-trap them, and the transportation to the release points would make this alternative extremely expensive (Weise et. al. 1975). Also, the reintroduction of these large predators in a state as densely populated as New Jersey could result in many undesirable repercussions. The animals would be reintroduced into an area and terrain with which they were completely unfamiliar. Their behavior could be quite abnormal and they may react aggressively in any encounter with domestic animals or humans. Because of the expense and the unknown reaction of the predators, the reintroduction of natural predators as an alternative to the proposed action is not recommended.

Bobcat, coyote and black bear already inhabit the State of New Jersey with no measurable impact on the deer population. Fifty-two thousand deer are not going to be taken by a few predators. These animals scavenge deer carcasses more than they prey on live deer. When a predator takes a live deer, it is usually a one to two month old fawn, or an injured deer that falls prey.

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- 1675 The first statutes of the Province of New Jersey, known as the “Concessions and Agreements,” provided for a bounty of 15 shillings for each wolf killed in the province (Brewster 1911). This was the first wildlife regulation in New Jersey’s history.
- 1678 The “Concessions and Agreements” officially granted the privilege to hunt and fish on unsurveyed land, through 1722 (Brewster 1911).
- 1679 The General Assembly prohibited the export of dressed skins from deer killed by Indians (Brewster 1911).
- 1722 An Act of the General Assembly established a season for the killing of deer (Brewster 1911). This was the first regulation which provided for the protection of game.
- 1757 A regulation was passed preventing the setting of deer traps within the Province of New Jersey (Brewster 1911).
- 1765 An Act was passed by the General Assembly to prohibit deer hunting at night (Brewster 1911).
- 1771 An Act was passed by the General Assembly which set the open season for deer hunting from September 1 to December 31. The regulation also made it unlawful to trespass while carrying a gun or to hunt deer with the aid of a dog (Brewster 1911).
- 1772 Deer hunting was prohibited in the Township of Morris (Morris County) for five years by an Act of the General Assembly (Brewster 1911).
- 1776 Deer hunting was restricted to an individual’s own land between September 1 and January 1 by an Act of the General Assembly (Brewster 1911).
- 1798 An Act of the General Assembly “suppressing immorality,” made it unlawful to shoot, hunt or gun, or make use of any seine or net to take fish on Sunday (Brewster 1911).
- 1853 An Act of the General Assembly protected deer in Bergen, Ocean and Atlantic Counties for five years (Brewster 1911).
- 1862 The General Assembly passed an Act which prohibited deer hunting for five years throughout the State (Brewster 1911).
- 1874 The deer season was reduced to 2 1/2 months (October 15 to December 31) and was prohibited in Burlington and Ocean Counties for five years (Brewster 1911).

1876	County wardens were appointed (Musick 1974).
1883	The State was closed to deer hunting by Acts of the General Assembly (Brewster 1911).
1892	The commission form of wildlife administration was initiated in New Jersey. Three Commissioners were appointed, and the first salaried Fish and Game Protector and County Wardens were hired (Brewster 1911).
1900	The deer population reached its lowest level in New Jersey.
1901	The total deer harvest was 20 deer.
1902-1908	An Act of the General Assembly closed the State to deer hunting (Brewster 1911).
1904-1913	This was the period of deer restocking in New Jersey. Deer were obtained from private preserves and parks, and from other states including Pennsylvania and Michigan (Board of Fish and Game Comm. 1904-1913).
1909	An Act of the General Assembly established an annual open season on deer which has been held every year henceforth. The first seasons were four days long (every Wednesday in November). Other restrictions prohibited hunting deer with dogs, night hunting and killing deer without visible antlers (bucks only). Violations called for a \$100.00 fine (Brewster 1911).
1912	The first reports of crop damage from deer were recorded (Board of Fish and Game Comm. 1912).
1915	The first statewide, Either-sex season was held. The season was four days long and 481 deer (291 bucks and 190 antlerless deer) were harvested (Board of Fish and Game Comm. 1915).
1917	A regulation was passed allowing farmers who had valid deer complaints to acquire a permit to shoot any deer observed damaging his crops (Board of Fish and Game Comm. 1917).
1928	A regulation was passed requiring deer killed during the prescribed season to have antlers at least three inches long (Board of Fish and Game Comm. 1928).
1933-1935	An antlerless season was held in the Counties of Sussex, Morris, Bergen and Burlington where crop depredation was a serious problem (Board of Fish and Game Comm. 1933-35).
1935	This was the peak year for the deer of the pine barrens region of South

Jersey (Howard 1972).

- 1947 A regulation was passed permitting the hunting of deer with bow and arrow during the regular Firearm deer season (Div. Fish and Game 1947).
- 1948 Bow and arrow licenses were required (Div. Fish and Game 1948).
- 1949 A Bow and Arrow season was established (December 5 through 10) and the legal hunting hours were 7:00 a.m. to 5:00 p.m. (Div. Fish and Game 1949).
- 1950 Only one deer (antlered buck) could be taken by bow or gun per year (Div. Fish and Game 1950).
- 1951 A regulation was passed permitting an antlerless deer season in Essex, Somerset, Morris and Union Counties. A special season was held on January 19 and 20, 1952 (Div. Fish and Game 1951).
- 1952 A regulation was passed allowing bow and arrow hunters to harvest a deer of either sex. The Bow and Arrow season was held with the small game season (Div. Fish and Game 1954).
- 1954 The Bow and Arrow season preceded the small game season (Div. Fish and Game 1954).
- 1957 The North Jersey deer population reached its peak (Howard 1972). A limit of one deer per season was established (Div. Fish and Game 1957).
- 1959 A three day antlerless deer season was held in the following North Jersey Counties: Bergen, Essex, Mercer, Middlesex, Morris, Passaic, Somerset, Sussex, Union and Warren. A total of 10,868 permits were issued on a first come - first serve basis, and 3,571 deer were harvested. The post card reporting system was initiated (Div. Fish and Game 1959).
- 1961 A statewide, one day "hunter's choice" season was held on January 31, 1962. A total of 12,406 deer were killed during the 1961 seasons (Div. Fish and Game 1961).
- 1962-1963 A "party permit" system was instituted. Four hunters could obtain one permit to kill one antlerless deer during the Six-day Firearm season. A total 3,525 permits were issued in 1962 and 3,700 permits were issued in 1963. The "hunter's choice" concept was continued during the Six-day Firearm season in the developed area of northeastern New Jersey (Div. Fish and Game 1962-63).
- 1964 An Either-sex Permit deer season was established (Div. Fish and Game 1964).

1965	No special season for deer of either-sex was held (Div. Fish and Game 1965).
1966-1996	Either-sex, Permit deer seasons were held on a county or zone basis.
1968	The New Jersey Outstanding Deer Program was initiated.
1971	A regulation was passed prohibiting the practice of hunting over bait. The law forbids hunting while elevated in a tree stand or in a structure of any kind within 300 feet of a baited area (Div. Fish and Game 1971).
1972	The deer check station system replaces the pre-paid, postcard system for reporting legal deer kills. The compound bow was authorized for hunting in New Jersey (Div. Fish and Game 1972).
1974	The Special, Either-sex, Permit deer season marked the implementation of the deer management zone concept as a management tool. Political subdivisions were replaced as management units (Howard et al. 1974).
1975	Rifled slugs were legalized for deer hunting. The first Winter Bow and Arrow season was held (January 3 through 10, 1976) (Burke et al. 1976).
1976	Muzzle loading rifles were authorized for deer hunting in deer management zones 1, 4, 18 and 23 during the Six-day Firearm season and in zones 1 and 4 during the Either-sex Permit deer seasons (Div. Fish, Game and Wildlife 1986).
1978	The first separate Permit Muzzleloader season was established (Div. Fish, Game and Wildlife 1986).
1979	All of the State, except a small area of Zone 22, was open for the Permit Shotgun season (Div. Fish, Game and Wildlife 1986).
1980	The Second Tag Program was instituted for the Fall Bow and Arrow and the Six-day Firearm seasons (Div. Fish, Game and Wildlife 1986).
1981	The Permit Shotgun season was expanded from one day to two days in six zones (Div. Fish, Game and Wildlife 1986).
1982	Juvenile license holders, aged 10-14 years, were allowed to apply for Special Shotgun season permits (Div. Fish, Game and Wildlife 1986).
1984	The first Extended Fall Bow and Arrow season was held in Zones 13, 36, 49, 50 and 51. The Permit Shotgun season was expanded to three days and the bag limit was increased to two deer in zones 9, 13, 14, 41, 50 and 51. A second tag for deer with antler at least three inches long was approved for the Permit Muzzleloader and Winter Bow and Arrow seasons (Div. Fish, Game and Wildlife 1986).

- 1985 Deer killed under second tag provisions for Permit Muzzleloader and Winter Bow and Arrow seasons could be either-sex and any age (Div. Fish, Game and Wildlife 1986).
- 1986 The Permit Bow and Arrow season replaced the Extended Fall Bow and Arrow season in selected zones. A new special permit application and issuance system was adopted offering applicants alternate zone choices and the opportunity to apply under a “buddy system” (Div. Fish, Game and Wildlife 1986). It became illegal to spotlight deer from a vehicle while in possession of any weapon capable of killing a deer.
- 1987 The Permit Muzzleloader season was extended to 10 days. A deer management program was instituted at Round Vally Recreation Area (Zone 60).
- 1987-1998 Permit holders could purchase an additional bow, muzzleloader or shotgun permit in zones which had unissued permits (Div. Fish, Game and Wildlife 1986).
- 1988 The Permit Muzzleloader and Winter Bow and Arrow season lengths were increased by four days to 14 and 18 days, respectively. The Permit Shotgun seasons was expanded to five days in 14 zones and to seven days in Zones 9 and 13, including two days in January 1989. Deer management programs were instituted at the Edwin B. Forsythe (Zones 56, 57 and 58) and Supawna Meadows (Zone 59) National Wildlife Refuges and the Atlantic County Park System (Zone 61). (Div. Fish, Game and Wildlife 1989).
- 1989 The Winter Bow and Arrow season was expanded to 22 days. Legal hunting hours for the Permit Muzzleloader and Shotgun seasons were changed to sunrise to one half hour after sunset.
- 1990 Hunters are allowed to apply for two special season deer permits during via the mail-in lottery system. The Permit Muzzleloader season was increased to 15 days. The Permit Shotgun season was expanded to six days in 13 zones; to seven days in 8 zones; and, to eight days in Zones 9 and 13. A Permit Shotgun season was authorized for Monmouth Battlefield State Park (Zone 64). A remedial Sportsmen Education Program was established and individuals who lose their license privilege because of a violation must successfully complete the program before they can purchase another license. Other laws enacted required all firearms to be cased while in a motor vehicle; prohibited loaded firearms or nocked arrows within 450 feet of a building or school playground; and, prohibited shooting from any publicly traveled roadway (Div. Fish, Game and Wildlife 1991).
- 1991 The Permit Bow and Arrow season was expanded from 19 to 25 days.

The Permit Shotgun season in Great Swamp National Wildlife Refuge (Zone 38) was decreased from 6 to 5 days, but the bag limit was increased from one deer per day to two deer per day. The Division initiates the "Hunt Smart" Campaign, an extension of the Division's efforts to educate the hunter and place an efficient and responsible sportsman in the field (Div. Fish, Game and Wildlife 1992).

- 1992 A special muzzleloader rifle scope (1.5x) permit is authorized for visually impaired hunters. The Permit Shotgun season was expanded to seven days in 19 zones, and ran concurrent with the Six-day Firearm season (Dec. 7 and 12, 1992) in Zones 9 and 13 (Div. Fish, Game and Wildlife 1993).
- 1993 The "Bonus Deer Tag" Program, allowing for the taking on one additional deer to hunters who harvest an antlerless deer first during the Fall Bow and Arrow season, was initiated in 10 zones (Zones 7-13, 39-41). The Permit Shotgun season was increased to nine days in Zones 9 and 13, and the season bag limit was increased from two to three deer per permit in 11 zones (Zones 9-13, 36, 41, 47, 49, 50 and 63). A deer management program was instituted at the Wallkill River National Wildlife Refuge. A controlled deer hunt was authorized Watchung Reservation (Union County Division of Parks and Recreation) during the special shotgun permit season (Div. Fish, Game and Wildlife 1994).
- 1994 The "Community-Based Deer Management Program (CBDMP)," designed to assist local authorities in dealing with deer population problems in urban/suburban areas, is initiated. Use of deer decoys during the archery seasons was authorized on an experimental basis in 12 zones (zones 9, 13, 21, 23, 24, 36, 37, 39, 40, 42, 49 and 52). The Bonus Deer Tag Program was expanded to 23 additional zones, and was authorized in Earle Naval Weapons Station Depot (Zones 39 and 40) and Supawna Meadows National Wildlife Refuge (Zone 59) during the Permit Bow season, and in zones 13 and 36 ("Hunter's Choice Area") during the Six-day Firearm season. The Permit Bow and Arrow season was extended through Dec. 31, 1994 (43 days) in Zones 13, 36 and 39. The Permit Shotgun season was expanded to eleven days in 10 zones. The Winter Bow and Arrow season was expanded to 26 days. The use of 16 and 20 gauge buckshot, as well as copper slugs was permitted for deer hunting (Div. Fish, Game and Wildlife 1995).
- 1995 The Bonus Deer Tag Program was expanded to 11 additional zones, bringing the total number of Bonus Tag zones to 42, resulting in a record season harvest of 15,821 deer. The Permit Shotgun season was expanded to fifteen days, with a four deer per permit bag limit in 12 zones. The Permit Shotgun season for persons possessing a farmer shotgun season permit was increased to include the Six-day Firearm season in the farm occupied by the permittee. A deer management program was reinstituted at the Federal Aviation Administration's William J. Hughes Technical

Center (Zone 66) after a 10 year absence. Deer hunting was allowed on the Cape May National Wildlife Refuge for the first time since its creation in 1989. The first Memorandum of Understanding (MOU) under the CBDMP was signed by the Union County Division of Parks and Recreation (DPR), resulting in 167 deer culled by DPR agents (Div. Fish, Game and Wildlife 1996).

1996 The use of deer decoys was permitted statewide during the archery seasons. The Fall Bow and Arrow season was reduced in duration from six to four weeks (Oct. 5 through Nov. 1, 1996). The Bonus Tag Program was expanded from single tags to multiple tags in 28 zones. Seven other zones retained the single bonus tag provision. The "New Jersey Supplemental Deer Permit and Transportation Tag" (formerly the Second Deer Tag), was valid on the date of issuance during the Six-day Firearm season in Zones 16-35, 37, 39, 42-49, 51-53, 55, 61-63 and 65. The Permit Muzzleloader season was expanded to 16 days, including two days prior to the Six-day Firearm season. The Permit Shotgun season was expanded to fifteen days (4 deer per permit) in 7 additional zones, and from fifteen to eighteen days in Zones 13 and 36 (Hunter's Choice Area), including three days in November 1996. The Winter Bow and Arrow season was expanded to 28 days (Jan. 1 through Feb. 1, 1997) and ran concurrent with the Permit Muzzleloader and Shotgun seasons, resulting in a record season harvest of 1,141 deer. A MOU was signed under the CBDMP by the Morris County Park Commission, resulting in 138 culled through a combination of controlled hunting and culling by agents (Div. Fish, Game and Wildlife 1997).

1997 An MOU was signed under the CBDMP by the City of Summit (Union County) allowing for the use of live trapping and relocation to a commercial deer farm or research facility. The Fall Bow and Arrow season was increased in length from four to seven weeks (September 13 - October 31, 1997) in zones 13, 36, 42 and 49. The Single Bonus Tag provision was deleted from the Fall Bow season and the number of Multiple Bonus Tags zones was increased to 32. The Multiple Bonus Tag provision was extended to 34 zones during the Permit Bow season. The Permit Muzzleloader season was shortened from 16 to 10 days in 2 zones (21 and 43). The Permit Shotgun season was expanded from 15 to 16 days in 5 zones (11, 25, 35, 47, 63); from 15 to 22 days in 12 zones (5, 7-10, 12, 14, 41, 42, 49-51); and, from 18 to 25 days in two zones (13, 36). A deer management program was instituted at High Point State Park (Zone 67) (Div. Fish, Game and Wildlife 1998).

1998 Rifle scopes are permitted for hunting with muzzleloader rifles and smoothbore muzzleloaders, without restriction on magnification power. Visually impaired persons are no longer required to obtain a Special Muzzleloader Scope Permit. Supplemental and Bonus Deer Transportation Tags will be valid on the date of issuance for all applicable seasons in the following zones, exclusively: Zones 16-19, 21-31, 33-35, 37,

39, 42, 43, 45-49, 51-53, 55-59, 61, 63, 65 and 66. The bonus tag program was expanded to the Permit Muzzleloader and Winter Bow seasons where these seasons are open in Zones 2, 5-15, 17, 19, 22, 25-31, 33-36, 39-42, 46-51, 57-59, 61, 63, 66 and 67, exclusively. The "Hunter's Choice" provision was deleted from the Six-day Firearm season in Zones 13 and 36. Deer Management Zone boundaries were changed as follows: Zone 44 was combined with Zone 30; Zone 32 was combined with Zone 45; and, Zone 20 was combined with Zones 19, 21, 23 and 24. The Permit Shotgun season reached a maximum 31 days in Zones 13, 36 41 and 50. The Fish and Game Council authorized a two-week extension of the Permit Shotgun season in Zones 7, 8, 10, 11, 12 and 41 in response to County Board of Agriculture complaints.

1999

2000